Aches & Pains in Kids:  
Pearls & Pitfalls of the Knee

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Financial Disclosure

No Relevant Conflicts

Case #1

- 12 y/o female gymnast
- Knee popped when she landed
- "Went out and back in"
- Swelled
- Trainer thought it was a transient patellar dislocation
- R.I.C.E. by trainer at the meet
- Recommends PT

R. I. C. E. = Rest, Ice, Compression, & Elevation
PC Provider Evaluation

- Improving, but still swollen
- Anxious to return as meet season starts in 3 mos
- Level VIII
- Injured knee slightly swollen but bends
- Hurts to move the knee cap
- Hard to get her to relax
- Collaterals stable
- Hyperextends her elbows

Dx & Rx & F/U

- Sprained knee, probably patellar dislocation
- Sports PT referral
- F/U in 2 weeks if not resolved
- Sees PT who agrees it’s her patella
- Starts exercise program and has her doing her PT program at the gym
- Swelling goes down and she gradually returns to full activities in 4 weeks
- One month later qualifies for level IX
- Life is good!

First meet of the season

- Lands, twists, and her knee goes out again
- This time even more swollen
- Lots of tears, etc
- Mother wants to know what went wrong and how soon she will be back as college scouts will be at upcoming events
- They’ve invested in her gymnastics training rather than saving for college...
- MRI: Complete ACL tear with displaced bucket handle medial meniscus 😞
What is your DDx?

12 y/o gymnast, acute knee injury

- ACL
- Patellar instability
- MCL, LCL
- Fracture
  - Physeal
  - Tibial spine
  - Pathological
- Meniscus
  - Regular tear
  - Discoid

ACL’s in Kids

Mechanism:
- Open field cutting injury without contact
- Contact injury
- Hyper-extension
- Hyper-flexion

Natural History

- Bleak
- Re-injury
  - 90%
  - Menisci
  - Articular cartilage
  - Often irreversible
  - Raises the risk of osteoarthritis
Knee Ligaments in Children

- Anatomy
- Can occur with femur fractures
- Physis is not always the weak link
- Conventional tunnels cross the physes!

Acute Patellar Dislocation

Sports:
- FB
- Baseball
- BKB
- Gymnastics
- Dance
- Simple falls…

Intrinsic Biomechanics

Shallow groove = more unstable
**Extrinsic Biomechanics**

Dynamic
- Femoral anteversion
- Ext tibial torsion
- Pes planus
- Generalized laxity
- Genu valgum
- Weak core
- Lumbar lordosis
- Weak gluts
- Tight adductors

**MCL History**

- Foot planted
- Valgus load
- Two dudes…

**MCL Rx.**

*Depends upon the severity of injury*
- Rest, Re-eval, early Return
- PT, Functional return, Protect
- Rarely surgery
Typical MCL injury

Weak link depends...

Physeal Fractures
Insert the xray example showing that the finding may be subtle - demonstrated by the stress xray.

Michael Busch, 9/22/2013
Physeal Fractures

- High rate of growth disturbance

Tibial Plateau Fracture

Pathological Fractures

- Most common: NOF
- Very common
  - 10% of all kids
  - “Knee” is the most common location
  - Most never need anything done

NOF = Non-Ossifying Fibroma
Example of a path fx thru an NOF

Michael Busch, 9/22/2013
“Something Nasty”

Tibial “Spine” Fractures

- A.K.A. Tibial Eminence
- ACL variant
  - Avulsion of the tibial end
- Need to look closely…
- Cast / Arthroscopic rx.

Torn Meniscus

- Variety of patterns
- Total meniscectomy = bad long-term
- Some repairable
- Generally: “be more aggressive”
Discoid meniscus

- Congenital abnormality
- Lateral (rare medial)
- Incidence 3-5%
- Most asymptomatic
- ~15% bilateral
- Familial factor

Meniscus "Sculpting"
What Could Have Been Better?

- History
  - Did anyone see the patella out?
  - Prior injury?
  - Other knee?
  - Family Hx?
- PE
  - Gait
  - ROM
  - Patellar apprehension test
  - Inadequate exam: repeat, consult, or MRI

What Could Have Been Better?

- Impression
  - Don’t let trainers, ED, or others overly influence you
  - Think through the DDx
  - Effusion is probably a dividing line between clinical and further evaluation
- Plan
  - Imaging?
  - If you’re not certain, have a backup plan
    - Consult
    - Mandatory re-evaluation before return to sport

What’s New?

Micheli Anterior Cruciate Ligament Reconstruction in Skeletally Immature Youths

A Retrospective Case Series With a Mean 3-Year Follow-up

S. Cintron-Wilkinson, MD, Christopher R. Jones, MD, Mackenzie M. Herzog, MPH, Keith H. May, PT, DPT, SCS, ATC, CSCS, Melissa J. Leake, MS, ATC, and Michael T. Busch, MD

Investigations performed at Children’s Orthopaedics of Atlanta and Children’s Healthcare of Atlanta at Scottish Rite, Atlanta, Georgia, USA

Am Jour Sport Med, 2015
Growth Remaining Groups - Boys

- >5 cm
- 1-5 cm
- <1 cm

<table>
<thead>
<tr>
<th>Growth Remaining</th>
<th>Girls</th>
<th>Boys</th>
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<tr>
<td>&gt;5 cm</td>
<td>≤10</td>
<td>≤12</td>
</tr>
<tr>
<td>1-5 cm</td>
<td>11-12</td>
<td>13-14</td>
</tr>
<tr>
<td>&lt;1 cm</td>
<td>13+</td>
<td>15+</td>
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</tbody>
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Growth Based Surgical Strategy

- Standard procedure
- Trans-physeal
- Micheli

Micheli - For the very young

Kocher, Garg, Micheli JBJS 2005
What Did We Learn?

- Highlights
  - 22 knees in children with 3 or more years of growth
  - Only outcome series other than Micheli (Boston)
  - 2 graft tears, both late
  - Excellent function and outcome scores
  - No growth disturbances, infections, etc
- Conclusion
  - Safe and effective in very young kids

What Did You Just Learn?

- Lots of things to consider in the injured knee
- ACL’s are often missed initially
  - Tough exam acutely
  - Plenty of imitators, particularly patellar instability
- Returning to sports with an unstable knee is a very bad idea
- Effusion is probably a red flag in knee injuries
- When in doubt:
  - Image
  - Consult
  - Re-examine
Knee Case # 2

Initial complaint:
• 12 y/o boy
• 3 months
• Generalized knee pain
• Progressive
• Baseball catcher
• Knee brace and NSAID's without success
• No history of trauma.

Key Questions to Ask

Basics
• Age, Gender, Weight
• What kind of problem?
• Where? - point
• One knee or both?
• What sports and how competitively?
• Similar problems in the past?
• Vitamin D intake?

Key Questions to Ask

Time line
• When did it start?
• What were you doing?
• Was there an injury or just start hurting?
• Changes in activity in the recent past?
Key Questions to Ask

Quantitate the pain
• How “big” is it?
  – Severity: 1 to 10
  – Limp?
  – Affect PE or activities?
  – Miss school?
  – Need medicine?
• How often: times per week or month?
• How long: sec, min, hours, all day?

Key Questions to Ask

Mechanical symptoms
• Catching
• Popping
• Locking
• Grating
• Giving way
• Visible effusion

Key Questions to Ask

Inflammatory
• Red, warm, swollen
• Fever, rash, weight loss, malaise
• Family hx of inflammatory arthritis
Key Questions to Ask

Exacerbating factors
- Running
- Jumping
- Stairs
  - Up
  - Down
- Sports - specifics
- Night pain?

Key Questions to Ask

Home remedies & response
- Meds
  - Need dosage, frequency and weight
- Ice / heat
- Knee brace
  - Solid / flexible
- Arch supports

Key Questions to Ask

Prior evaluation and rx
- Who?
- What did they think?
- What did they do?
- Response?
Key Questions to Ask

Closing: two open ended Q's
• Anything else important for me to know?
• What do you think it is?

DDx: “Generalized” Knee Pain
• Patellofemoral pain
• Chondromalacia
• Plica / Fat pad
• Osteochondritis Dissecans
• Discoid meniscus
• Tumor
• Indolent Infection
• Inflammatory arthritis
• SCFE!
**DDx: “Generalized” Knee Pain**

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DDx: “Localized” Knee Pain

- Osgood Schlatter
- Sinding-Larsen-Johansson
- Bipartite patella
- Torn meniscus
  - Torn discoid
- Osteochondroma
- OCD
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Osteochondritis Dissecans

**Etiology**
- Necrosis of subchondral bone
- Pathogenesis
  - Repetitive loading
  - Vitamin D?
  - Genetics?


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Osteochondritis Dissecans

**Presentation**
- Very vague pain
- Localized pain
- Can progress to loose body symptoms
- Easily missed
- May be subtle on plain radiography

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Osteochondritis Dissecans

**Clinical significance**
- Treated early: ↑ potential for healing with excellent outcome
- Delay in dx:
  - Lower rates of healing
  - Long, slow healing
  - Long times out of sports/activities
  - ↑ Potential for displacement
  - Challenging resurfacing problem
  - ↑ Risk for osteoarthritis
What’s New?

"Age Predicts Disruption of the Articular Surface of the Femoral Condyles in Knee OCD"

- 139 OCD cases (here) analyzed for age, MRI and scope findings
- Age alone was highly accurate <13 or >16
- MRI 94% sensitive and 97% specific, so very helpful for ages 13-16
- MRI is very helpful in the mid-range age group to predict the status of the surface, which in turn highly influences most rx algorithms

Busch M J Pedo Ortho 2016

Avoiding the Pitfalls

- Always watch them walk
- Always examine the hip
- Clinical diagnosis for localized source of knee pain
- Tentative diagnosis for generalized knee pain
- Role of over-activity and Vitamin D deficiency?

Avoiding the Pitfalls

- Evaluation and rx in proportion to the complaint, but...
  - Need to see a response to rx
  - Need to have follow-up
- Consult or imaging
- Document
- Timely diagnosis of OCD
  - Early = advantage
  - Late = possible consequences
“In America, you have forgotten to teach your children to play chess.”

Haluk Altok, MD

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