ACL Reconstruction in the Skeletally Immature Patient in 2014

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Once an adult injury, ACL tears are on the rise in kids
Increase linked to better diagnostics and dramatic growth in competitive sports
August 25, 2013 By Julie Dearidorff, Chicago Tribune reporter

ACL tears

Slide courtesy of Min Kocher
## ACL

- Increased Frequency
  - Recognition
  - Technology
  - Participation/Competitive Level

## Prevention: Ready, Set Prevent

- Forward and backward running
- Side shuffle
- Carioca
  - Children’s Hospital Philadelphia 2011

## Prevention: Balance Board / Bosu Ball

- Warm up
  - Jog 50 yd, shuttle run 50 yd forward and backward
  - Stretch calf, quad, hamstring, adductors, hip flexors
  - Walking lunges 20 yd X2
  - Russian hamstring x30
  - Single toe raise x 30
  - Plyometrics
    - Lateral hops, forward hops, single leg hops, vertical jump, scissor jump, 30 seconds each
  - Shuttle run 40 yd, diagonal run 40 yard, bounding run 50 yard
Prevention: does it work?

- Kevin Shea AOSSM 2013
- “Evidence shows that injury prevention programs may reduce the risk of some knee injuries, but additional research is necessary”

ACL

- Acute Hemarthrosis
  - ACL Injury/Skeletally Immature:
    - 10%-65% in series of 25-138 pts
      - Eiskjaer 1988
      - Kloeppe-Wirth 1992
      - Stanitski 1993
      - Vahasarja 1993

ACL

- Diagnosis by history and physical
- Heard a POP
- Immediate swelling
- Positive lachman and pivot shift exam

ACL

- MRI confirms the diagnosis
- Is MRI necessary??
  - Concomitant injury
  - Will MRI change management?
ACL

• Change in Approach
  – What we used to do…

ACL: Prognosis of Nonoperative Management is BAD

• (Angel & Hall (Arthroscopy 1989)
  » 5/7 failure (ACL reconstruction)
  – Graf et al (Arthroscopy 1992)
    » 7/8 failure (ACL reconstruction, meniscal tears)
    » 16/23 failure (ACL reconstruction)
  – Mizuta et al (JBJS-B 1985)
    » 1/18 return to preinjury sport level, 6/18 meniscal tears

Pediatric Knee Injuries
Partial ACL Tears

• Kocher et al (AJSM 2002)
  – Patients
    • Skeletally Immature
    • Arthroscopically Documented Partial Tear
      – 45 pts, 13.9 yrs old, 6.1 yr F/U
  – Exclusion Criteria
    – Initial ACL Reconstruction
      » Repairable Meniscal Tear
      » Grade C or D Lachman Exam
      » >6 mm side-side difference
      » Grade C or D Pivot-Shift Exam
      Clunk or Gross
  – Treatment
  – Outcome
    – 31% (14/45) Subsequent Reconstruction

ACL: Prognosis of Nonoperative Management is BAD

• McCarroll et al (AJSM 1988)
  » 3/16 return to preinjury sport, 4/16 meniscal tears

• Ganley et al (AJSM 2013)
  » Metaanalysis showed that early stabilization resulted in more stable knee and more reliable return to play

• Wells, Ganley et al (AJSM 2011)
  » Delay of ACL reconstruction greater than 12 weeks: increase in irreparable meniscus tears and lateral compartment cartilage damage
ACL

- Nonoperative management
  - If the patient can REST reliably
  - Bad things can happen in the ACL deficient knee…
    - Meniscal tears
    - Damage to the cartilage
    - Symptomatic giving way

ACL: What we do for adults

- Surgery:
  - “Classic” reconstruction crosses the growth plate

- Have you ever seen a growth disturbance from ACL reconstruction in a skeletally immature pt?
  - Kocher et al (JPO 2002)
    - 8 Cases: Distal Femoral Valgus with Bony Bar
      - 3: Implants (Interference Screws) across Physis
      - 3: Patellar Tendon graft bone block across Physis
    - 1: Large (12 mm) Tunnel with Patellar Tendon graft
    - 1: Over-the-Top Graft Placement
    - 2 Cases: Genu Valgum without Bony Bar
      - Lateral Extra-Articular Tenodesis
    - 2 Cases: Leg-Length Discrepancy
      - 2.5cm shortening (PT bone block across physis)
      - 3.0cm overgrowth (6mm hamstrings graft)
    - 3 Cases: Recurvatum with Apophyseal Bar
      - Hardware across Tibial Tubercle Apophysis

Pedi ACL Algorithm

- General Approach:
  - Prepubescents:
    - Tanner 1, ≥2 cm growth remaining, ≤12 years old
    - Nonoperative Management
    - Operative Management: Non-Transphyseal Reconstruction
  - Adolescents with substantial Growth Remaining:
    - Tanner 2, 1-2 cm growth remaining, ≤14 years old
    - Nonoperative Management
    - Operative Management: Transphyseal with ST graft
  - Adolescents without substantial Growth Remaining:
    - Tanner 3, <1 cm growth remaining
    - Nonoperative Management
    - Operative Management: Transphyseal Reconstruction (HS vs PT)
Transphyseal ACL in Skeletal Immature: Special Considerations

- Use soft tissue
- Keep fixation away from physis
  - button for femur
  - Consider nonphyseal screw for tibia
- Make drill holes round, not oval, graft becomes more vertical

ACL

- IT BAND reconstruction (extraphyseal)

ACL: Guzzanti physeal sparing
AJOSM 2003
- HS harvested proximally
- Stapled into lat fem condylar notch

Pedi ACL Algorithm: non physeal techniques

- Iliotibial band Micheli-Kocher technique
- All epiphyseal (Allen Anderson/Ted Ganley) technique
Physeal Sparing ACL Reconstruction using ITB

- 44 patients 1980-2002
- Tanner stage 1 and 2
- 2 revisions
- Mean growth postop 21.5 cm
- No LLD or angular deformity

Secured to periosteum of proximal tibia (distal to physis)

- All inside technique
- Semitendinosus quadrupled graft
- Fluoroscopy
Epiphyseal Femur and transphyseal tibia

- For age 12-13
- Tibial physis closes first
- Tibial physis less likely to angulate