Adolescent Female Knee/ACL Injuries and Prevention

Camille Clinton, MD
ProOrtho
Background

- Native Seattleite
- Played most sports, but primarily soccer
  - High school, select, ODP, college
- College at Notre Dame
  - Hurt first game of freshman year
- Medical School at Georgetown
- Orthopedic Residency Georgetown
- Sports Medicine Fellowship Hospital for Special Surgery
  - Women’s Sports Medicine Center, Coverage of college and professional sports teams
- Practice in 2008
- Board Certified in Orthopedic Surgery
- Certification of Added Qualification Sports Medicine
ACL/Knee Injuries and Prevention

- Basic knee anatomy
- Common injuries
- ACL injuries
- ACL prevention
Knee Anatomy

- Bones
- Ligaments
- Cartilage
- Meniscus
Knee Injuries

- Overuse Injuries
  - Patellofemoral pain

- Traumatic injuries
  - ACL tears
  - Patella (kneecap) dislocations
  - Meniscus tears
  - MCL/LCL/PCL tears
  - Cartilage injuries
Evaluation of Knee Injuries

• Overuse vs. traumatic

• Mechanism of injury – contact, noncontact

• Swelling → No playing until evaluation, probably need MRI

• Loss of motion, especially loss of extension → needs further evaluation

• Some ACL and meniscus injuries will not have much swelling
Knee injuries

- Patellofemoral pain
  - Overloading between kneecap and groove it sits in
  - High forces – 6-7x bodyweight depending on activity
  - More likely with high Q angles, foot pronation, tight IT bands, hip weakness, VMO weakness
  - Common in adolescents
  - Usually gets better with PT, activity modification
  - If not, in certain settings realignment of kneecap works well
Meniscus Tears

- Meniscus –
  - Cartilage pad in the knee
  - Often twisting injury
  - May accompany ACL/ligament tears
  - In this age group repair if at all possible.
  - Still risk of re-tear/not healing
  - Long term bad injuries, especially if meniscus (or part of it) is removed
Cartilage injuries

- Overuse/chronic versus traumatic
- May be associated with ligament/other traumatic injuries. Less common with ACL injuries in girls than boys
- Multiple options available to repair/replace
Ligament Injuries

- **MCL**
  - Often heal even with ACL injury

- **LCL**
  - If partial/isolated may heal. If combined with ACL/PCL often require reconstruction/repair

- **PCL**
  - Relatively rare in sports. May heal. Can do well with non-operative treatment. Less studied than ACL tears
Patella Dislocation

- Knee cap dislocation
- Anatomy may predispose – valgus knee (knock-kneed), laxity, shallow trochlear groove
  - About 50% chance of recurrence, higher with certain risk factors
  - First time often non-operative treatment unless other injuries
Patella Dislocation

• Recurrence → patella stabilization with bony/soft tissue reconstruction depending on anatomy, age, predisposing factors

• Low recurrence rates – return to sports in 4-6 months
ACL Tears

- ACL prevents anterior translation and rotation in the knee
- ACL is not needed for walking, riding bike, activities in a straight line
- Very important for cutting, pivoting activities
- Most are noncontact injuries (70-80%)
- Often there are associated injuries – meniscus/cartilage
- Non-operative treatment in athletic populations leads to poor results → more injuries, and further damage in the knee.
- Increased risk of future arthritis
ACL Tears

- Becoming more common
  - 150,000-200,000/year, Costs $1-2 billion

- Treatable → ACL reconstruction
  - Can be safely reconstructed even in young children
  - Multiple options available
  - High success rate
  - Not everyone returns to prior level of sports

- Long rehab > 6 months

- Psychological strain

Sutton and Bullock, JAAOS 2013, Mall et al. AJSM 2014
Female ACL Injuries

- Why so much press??
  - ACL tears increasing in frequency, especially among females
  - Female athletes have 2-6 times the incidence of ACL injuries as male athletes
  - For collegiate soccer/basketball 4.5% per year vs. 1.7% in males. High school athletes up to 1/60
  - Lost scholarships, lost school days, psychological strain
  - Fear of injury/re-injury could lead to decreased sports participation which we know is valuable in girls
  - Increased risk of future arthritis

Paterno AJSM 2014
Female ACL injuries

- ACL reconstruction has high success
- Recurrent injury rates may be higher than originally thought – younger patients have a higher risk. Females have a higher risk. (Also technique issues can play a role.)
  - Risk of additional ACL injury in females within 2 years after return to play 20-29.5% (depending on study)
    - 70% occur in the contralateral knee
    - Overall 6 times more likely
    - Up to 15x more likely in the first year returning to play

Paterno et al AJSM 2014, Brophy et al. AJSM 2012
The Female Knee

- What’s the difference?
  - Anatomy –
    - wider pelvis, greater angle at knees (Q angle)
      - Puts more strain across knee
    - Narrow notch?
    - More tibial slope
    - Ligamentous laxity
  - Hormonal differences? → more risk during certain portions of menstrual cycle – data inconclusive

FACTORS WE CAN’T CHANGE
The Female Knee

FACTORS WE CAN CHANGE

- **Strength differences**
  - Higher Quad/hamstring strength and recruitment, slower hamstring activation
    - Hamstring contraction has protective effect – pulls tibia back
    - Quad contraction increases strain on ACL – pulls tibia forward
  - Athletes with ACL injuries had lower hamstring strength/recruitment, higher angular motion in the knee, more vertical position
The Female Knee

- Mechanical/Dynamic differences
  - Jump landing and cutting with knee more extended

- Hips more adducted

- Knee more likely to fall into valgus (fall in)
  - more valgus → more strain on ACL

- Upper body not over legs (core strength)
ACL Prevention

- Additional risk factors to be aware of (not gender specific)
  - Fatigue
  - Shoe Wear
  - Playing Surface
  - Family History
ACL Prevention

• Does it really work???
  
  • YES
    • Significant reduction in ACL tears and knee injuries
      • Up to 50-80% reduction – greatest reduction in noncontact injuries

• Barriers
  • Knowledge
  • Time
  • Compliance
  • Monotony

Gilchrist et al. AJSM 2008
ACL Prevention

When should we start?
- Sooner is probably better

What are the key components?
- At least 10 minutes, at least 3 times a week – bare minimum, more is better
- 8 weeks prior to season
- Warm-up
- Strength/power exercises
  - Hamstrings
  - Hips
  - Core
- Plyometrics
- Proprioreception/Balance
- Agility
- Flexibility

Myer G AJSM 2013
ACL Prevention

- Proper form is key when doing exercises
- PEP (SMSF), Sportsmetric – proven success
- Programs work better with feedback to athlete
  - Jump landing on ball of foot ➔ decrease ground reaction force
  - Knees bent and pointed straight ahead
  - Trunk over legs
  - Feet apart
ACL Prevention

- Other benefits
  - Increased vertical jump
  - Possible increased speed
  - Increased power/strength
  - Decreased rate of other knee injuries (not just ACL)
ACL Prevention

- Identify at-risk athletes – although recent study shows we should treat everyone (63% vs 40%)
  - Landing error scoring system
    - Start on box, land on floor and immediate vertical jump up
  - Post-operative patients
    - Attention to operative AND non-operative knee
  - Return to play criteria
    - Highest risk for contralateral knee within one year of return to play

Redler SE JBJS 2014
ACL Prevention

- All cutting/pivoting athletes should be in an ACL prevention program
- Try to catch athletes not in a program, especially at risk athletes
- Programs should start in pre-adolescence
- Including as part of the warm-up may increase compliance
- We should also be aware of overtraining/fatigue as risk factors
- If an injury occurs best surgical treatment and rehabilitation following
- Potentially adjust return to play criteria
References


• Paterno MV et al.: Incidence of Second ACL Injuries 2 Years After Primary ACL Reconstruction and Return to Sport. *AJSM* 2014; 42(7): 1567-1573.


References


THANKS