2017 Cook Children’s SPORTS Symposium

Immature ACL Injuries and Reconstruction

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Disclosures

- I have no financial/industry disclosures.
Objectives

• Explain the importance of skeletal immaturity on treatment and reconstruction type

• Compare the various reconstruction techniques available in the skeletally immature patient

• Summarize the potential implications of ACL injury in this age group
Immature ACL Injury

- 8 year old with original injury of playing football
  - instant swelling; inability to return
  - MRI confirmed ACL tear
  - no meniscal pathology
  - Physeal sparing ACL reconstruction recommended by 2 surgeons
  - family elected to wait - lost to follow up
  - bracing recommended since non-operative course pursued
Immature ACL Injury

- Returns at age 10 with symptoms:
  - instability
  - inability to cut
  - pain
  - No new injury
  - not wearing any brace
Immature ACL Injury

- MRI confirms complete ACL deficiency and suggests no meniscal pathology
- Surgical management recommended
- Based on degree of skeletal and developmental maturity
  - All - epiphyseal ACL reconstruction with hamstring autograft is recommended.
Non-surgical Management

• Kocher 2002 - partial tears treated non-operatively
  • 2 year follow-up
  • 31% went on to reconstruction
  • Risk Factors for failure
    • tears >50% mid width
    • PL bundle
    • mildly positive pivot shift
    • older chronologic and skeletal age

• Concluded partial tears with near normal Lachman and pivot shift <14 could be treated non-surgically
Rationale for Reconstruction

- Vavken and Murray meta analysis *Arthroscopy* 2011
  - better clinical outcomes with reconstruction regardless of type than non-op
  - future stability and injury prevention

- Lawrence JT *AJSM* 2011
  - delayed management >12 weeks increased
    - irreparable medial meniscal tears
    - lateral chondral injuries
Rationale for Reconstruction

- Anderson and Anderson 2015
  - 135 patients; age 13y 8 m
  - Lateral Meniscal tear 2.6 times incidence with inc. grade
  - Medial Meniscal tear 3.5 times incidence with inc. grade

- Newman, et. al.
  - delay in surgery > 3 months increase risk of injury
  - increased irreparable meniscal injury
  - additionally surgery
ACL - Skeletally Immature

Pivot shift bone bruise pattern

Oblique images

Cruciates in plane
Proximal Tibia

- Tibial Spine/Eminence
  - ACL attachment
- Repaired surgically
- Can lead to late instability
  - requiring reconstruction
ACL Reconstructions

- Physeal Sparing
  - IT band
  - All - Epiphyseal

- Physeal Respecting
  - Mixed
  - Vertical Tunnels

- Skeletally Mature
Reconstruction Algorithm

ACL tear in the skeletally immature patient

Partial (<50% fibers torn)
- Activity modification
- Physical therapy
- Bracing

Prepubescent
- Tanner stage 1 or 2
  - Males ≤12 y
  - Females ≤11 y
  - Physeal-sparing combined extra- and intra-articular reconstruction with autogenous iliotibial band

Adolescents with growth remaining
- Tanner stage 3 or 4
  - Males ≤13–16 y
  - Females ≤12–14 y
  - Transphyseal reconstruction with autogenous quadrupled hamstring tendons and metaphyseal fixation

Older adolescents with closing physis
- Tanner stage 5
  - Males ≥16 y
  - Females ≥14 y
  - Adult-type anatomic ACL reconstruction with hamstring or patellar tendon (autograft preferable)
Bone Age

• Compared to Greulich and Pyle atlas

Bone age - all phyes open
Age 11 correlate
Immature ACL Injury

- IT Band combined Extra-artericular/Intra-artericular Reconstruction

Frank JS, Gambacorta PL JAAOS 2013
Immature ACL Injury

Various Fixation Methods

Anderson AF JBJS 2003
I prefer this technique in:

- Males 12 and under
- Females 11 and under
- Generally correlates with Tanner 1 & 2
- Will go with IT band usually under 10 depending on size of epiphyses

Older adolescents

- Physeal respecting
  - Smaller vertical tunnels
  - More like adult hamstring

- Mature reconstruction
  - BTB vs. Hamstring
All-Epiphyseal Intra-Op

Drills contained within epiphyses
All - Epiphyseal Post-Op
Growth Disturbance

- 1-1.8% incidence
  - Frosch 2010
  - Vavken and Murray 2011

- Iatrogenic
  - Direct violation of physis
  - Tethering of the physis by IT band method
Results

- IT Band
  - 4.5% revision rate
  - low rate of growth disturbance
  - controls rotation well
  - may over constrain the knee during some flexion angles

- All-Epipyseal (Outside in)
  - Cruz (2015) - 103 pts; 10% rupture; 1 pt with overgrowth
  - Anderson - 79 pts; 4 failures; 1 overgrowth
  - Anderson - 125pts with technique show similar success
Postoperative Management

- Long leg hinged knee brace for 6 weeks
- Inline running at 3 months
- Generally 9 months to 1 year out from sports (no consensus)
- Functional brace recommended for 1-2 years after return to sport. Little data to support this, but generally recommended.
Summary

- We covered the treatment options for Boys 12 and under and Girls 11 and Under

- Surgeon preference on IT band modified extra-intra-articular versus All-Epiphyseal

- Biomechanical and technical considerations on choice

- Similar results. Generally preferred to non-operative management.
References

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