Knee Injuries in Skeletally Immature Athletes
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Topics

* ACL Tears and Tibial Eminence Fractures
* Meniscus Injuries - Discoid Meniscus
* Osteochondritis Dissecans
* Patellar Instability

Pediatric ACL Tears

* Growing problem in children
* Werner et al. JPO 2015: 18.9% increase in injury rate and 27.6% increase in rate of ACL reconstructions from 2007 to 2011
* Increased single sport specialization, higher level of intensity, increased awareness
* Male football players and female soccer players at highest risk
* Females have an adjusted relative risk of 2.10 (Gomitzky et al. AJSM 2015)
Evaluation

* Non-contact, twisting injury associated with a “pop” and hemarthrosis
* Exam findings, such as positive Lachman and pivot-shift often limited in young, anxious patient
* Orthogonal knee radiographs and MRI
  * Assess for concomitant injuries and presence of open physis
  * Also consider hip-to-ankle films and PA of left hand

Treatment

* Non-operative treatment indicated for partial tears <50% and in select cases of complete tears
* Complete tears best managed with early stabilization, even if skeletally immature
  * Ramski et al. AJSM 2014
    * Higher rates of return to activity, better functional outcome scores and decreased medial meniscal tears

Surgical Technique

* Concern for physeal damage leading to growth arrest or angular deformity
* Few reports of use of proper technique
* Physeal sparing techniques have good outcomes
* ITB reconstruction has equally good results, but fewer patients reported
* Physeal-respecting techniques
  * Minimize tunnel diameter
  * More central and vertical tunnel drilling
  * Soft tissue autograft – quadrupled hamstrings
  * Metaphyseal fixation
  * Avoid dissection around perichondral ring

Transphyseal Reconstruction

* Physeal-respecting techniques
* Minimize tunnel diameter
* More central and vertical tunnel drilling
* Soft tissue autograft – quadrupled hamstrings
* Metaphyseal fixation
* Avoid dissection around perichondral ring
Transphyseal Reconstruction

- Kocher et al. JBJS 2007
  - 59 patients, 3.6 year follow-up, avg. age 14.7
  - 3% revision rate and no growth disturbance
- Kumar et al. JBJS 2013
  - 32 patients, 6 year follow-up, avg. age 11.3
  - One re-rupture and one occurrence of valgus deformity
- Calvo et al. AJSM 2015
  - 27 patients, 10.6 year follow-up, avg. age 13
  - Three re-ruptures and no growth disturbance

Postoperative Management

- May require more time for recovery than adult patients
- Even after 9 months, adolescent patients did not demonstrate adequate functional movement patterns to allow safe return to sport (Boyle et al. JPO 2016)
- 30% risk for additional ACL tear involving either knee in first 24 months after return to sport (Webster et al. AJSM 2014)

Tibial Spine Fractures

- Failure of incompletely ossified tibial plateau at insertion of ACL
- Plastic deformation of ACL
- 8 to 14 years of age
Evaluation

Similar injury mechanism to ACL tears

Acute knee pain with effusion and inability to ambulate

MRI often needed to evaluate for concomitant injury and blocks to reduction

Mitchell et al. JPO 2015

Anterior Horn Medial Meniscus Tear in 33% of Type II and 12% of Type III

48% meniscal entrapment in type III

Chondral injuries in 7% of all patients

Myers and McKeever Classification

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Treatment

* Closed Management of Type I and reducible Type II with cast immobilization either in full extension or slight flexion

* Open or arthroscopic treatment to achieve anatomic reduction with suture or screw fixation

* No fixation method or surgical technique has proven to be superior

* Increased length of surgery and delay of treatment >7 days have increased risk of arthrofibrosis (Watts et al. JPO 2016)

* Early mobilization is critical following surgery to avoid arthrofibrosis

Meniscal Tears

* Meniscus has adult-like characteristics by 10 years of age

* Non-contact twisting injury

* High association with ACL tears and tibial eminence fractures

* Symptomatic tears require surgical treatment

* More aggressive approach to repair

* Inside-out approach preferred

* All-inside technique avoided due to smaller distance to NV bundle
Discoid Meniscus

- Congenital anomaly resulting in an abnormal size, shape and attachment, almost always affecting the lateral meniscus
- Wantanabe Classification:
  - Complete (1), Incomplete (2), Wrisberg variant (3)
- Surgical planning considerations:
  - Complete or Incomplete?
  - Stable or Unstable?
  - Intact or Torn?

Evaluation

- MRI required for diagnosis

Treatment

- Asymptomatic discoid meniscus does not need treatment
- Arthroscopy indicated for symptomatic discoid meniscus
  - Saucerization and debulking leaving a 6-8mm rim
  - Repair remaining tears and peripheral rim if unstable after saucerization
  - Subtotal meniscectomy is salvage procedure and may later require meniscal transplant

Patellar Dislocation

- Most common acute knee injury in adolescent athletes
- Non-contact injury produced by valgus and internal rotation of a planted leg
- Patient may self-describe the dislocation and subsequent reduction
- Multiple factors direct management
  - Anatomic variations, generalized ligamentous laxity, recurrent dislocations, presence of loose body

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Evaluation

* Hemarthrosis, medial tenderness, possible VMO retraction
* If not reduced on presentation, gentle knee extension with medial force to achieve reduction
  * Consider positioning prone to relax hamstrings
* Plain X-rays – AP, lateral and merchant views
  * Consider full-length radiographs
* MRI
  * Osteochondral fragments
  * MPFL disruption and VMO retraction

Management

* Controversial

* Non-operative treatment generally preferred for first-time dislocation with no osteochondral loose body
  * Short period of immobilization with early aggressive rehabilitation focused on VMO, core, gluteal muscles

* Surgical treatment indicated when loose body present or history of multiple dislocations

Surgical vs. Non-surgical Management

* No difference in subjective/functional outcome or re-dislocation rates

    * Retrospective review of 126 patients with acute dislocation
    * 26% re-dislocation - no difference in surgical vs. non-surgical
  
  * Palmu et al. BJJS 2008
    * Prospective randomized trial of 74 acute patellar dislocations
    * Good subjective results in 75% non-op and 66% operative
    * 71% re-dislocation in non-op vs. 67% in operative

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Anatomic Considerations
- Tibial tubercle-trochlear groove distance
- Trochlear dysplasia
- Patella Alta
- Femoral Anteversion
- External Tibial Torsion
- Genu Valgum
- Generalized ligamentous laxity

Surgical Approaches
- MPFL Reconstruction
  - Multiple graft choices and fixation methods
  - Insertion just distal to physis
- Distal realignment
  - Tibial tubercle transfer
  - Not indicated in skeletally immature patients
- Guided growth
  - Hemiepiphysiodesis to address genu valgum
- Trochleoplasty

Return to Sport
- Redislocation rates are high, but patients do well overall
- 100% return to sports, but only 50% at previous level of ability

Osteochondritis Dessicans
- Focal, idiopathic alteration of subchondral bone
- Repetitive injury, genetic predisposition, vascular insult
- Most commonly located on lateral aspect of medial femoral condyle
Evaluation

- Symptoms often benign with a stable lesion
- Physical exam may be normal
- Imaging must include sunrise and notch views
  - Also consider bilateral images as well as full-length x-rays and bone age films
- MRI
  - Status of subchondral bone and stability of lesion

Treatment

- Early detection of stable lesion with prompt treatment is vital to success
- Stable lesions with open physis can heal without surgery
- Activity restrictions and bracing for 6-12 months!
- Surgery for unstable lesions and failure of non-op treatment
- Drilling and marrow stimulation of stable lesions
- Fixation of unstable lesions
- Salvage with OAT, osteochondral allograft or ACI

Thank You