Osteopathic Pediatric Knee Examination

AOBP with thanks to:

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Internal Knee Anatomy
External Knee Anatomy

- Femoral groove
- Patella
- Quadriceps tendon
- Medial patellofemoral ligament
- Patellar tendon
- Tibia
Bone Development

- At birth, only a few epiphyses have begun to ossify; the rest are cartilaginous.
- Before closure of physis during puberty, a growth plate is weaker than surrounding ligaments.
- Injuries near joints in children are more likely to result in physeal disruption than in ligament tearing.
  - Sprains and dislocations are seen less commonly in prepubescent children than in adolescents and adults.
Bone Development

- Avulsion fractures at sites where strong muscular attachments join secondary ossifications centers are unique to children and adolescents
- Growth disruptions can occur and are unique in children with epiphyseal fractures
- When epiphysis is not ossified, X-rays can fail to show fractures in children
Bone Development

- Periosteum is thicker in children
- Children’s bones are more flexible and respond to compressive forces differently
- Pediatric fractures heal more rapidly and remodel more than adult
Knee joint orientation

- Up until about 2 y/o, the knee joint has a more varus positioning due to in utero positioning
  - Persistence of this positioning beyond 2 y/o can be pathologic leads to the deformity Genu Varus (bowleg)

- By 4 y/o, a more valgus position is assumed with physiologic variations persisting until 6 y/o
  - Progression of this positioning leads to the deformity Genu Valgus (knock-knee)
Knee Pain

- Common complaint in older children and adolescents (MOST common site of musculoskeletal complaints in teens)
- Knee pain commonly associated with effusion
- Often can be referred from hip, thus exam of hip is also essential to finding cause of pain
Pediatric Exam Considerations

- Patient developmental level is major consideration
- Observation during play while taking a history may provide most information
- General screening of spontaneous movement, posture, gait, station and stance
- Last part of exam should be focused on the area of concern in a child
- Always compare affected side to normal side
Gait Observation
Gait

- Best observed having child walk back and forth in hallway
- Check shoes for signs of abnormal wear
- Most acute and many chronic gait disturbances in childhood are caused by pain
- Wide-based gait expected from onset of walking until 3 y/o
- By 3 y/o normal smooth and rhythmic heel-to-toe gait is expected
Knee Inspection
Osteopathic Knee Exam

- Palpation of knee is easier with knee flexed so landmarks are more easily seen and felt
- With knee flexed, muscles, ligaments and tendons are in a relaxed position
- Knee ranges of motion
  - Flexion: 130-140 degrees
  - Hyperextension: 5-15 degrees normal for child
  - Internal and external rotation: 10 degrees
Knee Mechanics

- **Flexion**
  - External rotation of the femur
  - Internal rotation of the tibia
    (Tibial motion due to contraction of the popliteus muscle)

- **Extension**
  - Internal rotation of the femur
  - External rotation of the tibia
    (Due to relaxation of the popliteus)
Flexion of knee
Extension of knee
Osteopathic Knee Exam

- Ligamentous stability of the knee should be assessed
  - Mediolateral plane
  - Anteroposterior plane (A & P drawer, Lachman)
  - Abduction/Adduction stress for collateral ligaments

- In acute knee injuries involving significant pain and swelling, exam should be deferred until after X-rays obtained due to potential fractures of growth plates
Valgus strain: test medial collateral ligament (open no more than 1 cm)
Varus strain: test lateral collateral ligament (open no more than 1 cm)
Anterior Drawer Test: for anterior cruciate instability (+ when tibia moves forward > 0.5-1 cm)
Posterior drawer test: for posterior cruciate instability (+ when tibia moves backward > 0.5-1 cm)
Lachman test: for anterior cruciate tears (+ if anterior displacement of tibia during posterior pushing on femur)
Osteopathic Knee Exam

- When knee landmarks are obscured with effusion and patella is ballotable consider the following:
  - Intra-articular hemorrhage (hemarthrosis)
  - Arthritis
  - Synovitis

- Check for fluid collections in bursae and suprapatellar pouch also

- Hemarthrosis are most common in ACL injuries and patellar dislocations
Patellar ballottement
Osteopathic Knee Exam

- Assess for tenderness along medial and lateral joint lines of the knee
- Apley compression test is used to assess meniscal integrity: (+) is pain with compression
- Assess lateral joint ligament laxity
- A (+) McMurray test implies meniscal injury
  - Positive if pain or limitation in either passive flexion or extension while rotating tibia
McMurray test.
Apley compression test
Knee Injuries

- Acute knee injuries that cause immediate disability in teens include the following:
  - Fracture
  - Patellar dislocation
  - Anterior cruciate ligament (ACL) injury
  - Meniscal tear

- If an athlete is able to bear weight and return to play within a few minutes after an injury, serious injury is less likely
Initial treatment of acute knee injuries

- If unable to bear weight or unstable knee
  - Immobilize the knee
  - Crutches
  - Plain radiographs

- Radiographs of the knee required if:
  - Isolated tenderness of patella
  - Fibular head tenderness
  - Inability to flex knee 90 degrees
  - Inability to bear weight for 4 steps (regardless of limping)
ACL injuries

- Most likely injury when a hemarthrosis is present within several hours after an injury
- Significant swelling and instability are hallmarks
- Caused usually by knee hyperextension injuries such as a direct hit, landing off balance from a jump or quickly changing direction while running
- Usually require orthopedic consult and surgical intervention, although conservative bracing also is used
Evidence-Based Medicine: ACL

- JAOA 2006 case report of OMT used before and after ACL reconstructive surgery
- 17 y/o patient with a torn ACL used conservative treatment for 10 years, had increasing pain in joint instability requiring surgery at 27 y/o
- 3 OMT sessions in the 3 months prior to surgery
- 3 months post-op patient started formal PT and re-started OMT initially weekly, then once a month
Evidence-Based Medicine: ACL

- Techniques used for OMT were mostly functional methods and other indirect methods.
- Areas of somatic dysfunction included cervical extending to ribs 1 & 2, thoracic (T3-5), lumbopelvic on side of injured leg extending up that side to ribs 6-9, and affected lower extremity.
- Post-op OMT also included specific dysfunction in the area of L2 after spinal anesthesia and upper extremities after crutches use.
- Patient achieved full level of activity 6 months after surgery including a return to playing basketball at pre-operative level with a functional knee brace.
Fibular Contributions

- Proximal tibiofibular joint allows motion of fibular head
  - Anterolateral
  - Posteromedial
- Fibular head lies in same horizontal plane as tibial plateau
- Peroneal nerve lies directly posterior to proximal fibular head
- Posterior fibular head motion is accompanied by anterior motion at the distal fibula
Fibular Head Dysfunction

- Check reciprocal motion between proximal and distal fibular heads
- External rotation of tibia = anterior proximal fibular head
- Internal rotation of tibia = posterior proximal fibular head
- Posterior fibular head somatic dysfunction can cause symptoms related to entrapment or compression of common peroneal nerve
OMT for Posterior Fibular Head

- Restricted anterior glide of proximal fibula
- Goal is to increase anterior glide of proximal fibular head
- Direct techniques with either thrust or muscle energy can be approached
OMT for Posterior Fibular Head: HVLA

- Patient is supine, physician standing on side of dysfunctional knee
- Flex hip and knee
- Cephalad hand in popliteal space with 1<sup>st</sup> MP joint posterior to fibular head
- Caudad hand grasps proximal to ankle
- Flex knee to point of barrier while externally rotating at ankle
- Apply HVLA thrust by flexing leg with caudad hand
OMT for Posterior Fibular Head: ME

- Patient supine with hip and knee flexed and affected foot on table, physician at foot of table
- Physician places hand on dorsum of foot, thumb on lateral surface of foot and fingers wrapped around medial side of foot
- Plantar flex foot to initial resistance and then also invert foot to resistance
- Have patient evert foot against doctor counterforce to draw fibula anteriorly, then relax, take up slack and repeat
- Repeat until best possible motion obtained
Normal heel-to-toe gait is expected at what age?

A. 15 months old
B. 2 years old
C. 3 years old
D. 4 years old
E. 6 years old
An 8 year old child presents to your office limping after a fall playing basketball during gym class 2 hours ago. He is limping. During an initial exam of his knees, which position should he be in for best evaluation?

A. Prone, legs extended
B. Seated, hips and knees flexed
C. Squatting, on toes
D. Standing, both feet flat
E. Supine, legs extended
A 16 year old male presents to the ER 3 hours after an injury during a football game. He has a large effusion of his left knee. Which of the following is the most likely diagnosis based only on presence of a hemarthrosis?

A. Chondromalacia patella
B. Lateral collateral ligament injury
C. Lateral meniscus injury
D. Patellofemoral syndrome
E. Patellar dislocation
A 14 year old cross country runner presents with knee pain and swelling after a race. Which of the following positive maneuvers would indicate an ACL injury?

A. Anterior drawer test  
B. Apprehension test  
C. McMurray test  
D. Patellar grind test  
E. Posterior drawer test
Question 5

- An 11 year old child presents to your office complaining of knee pain. Which of the following physical exam findings indicated a need for X-rays?

A. Clicking of patella on extension
B. Inability to extend knee beyond 5 degrees
C. Inability to flex knee to 90 degrees
D. Isolated tibial tuberosity tenderness to touch
E. Limping gait
References