

Osteopathic Pediatric Knee Examination



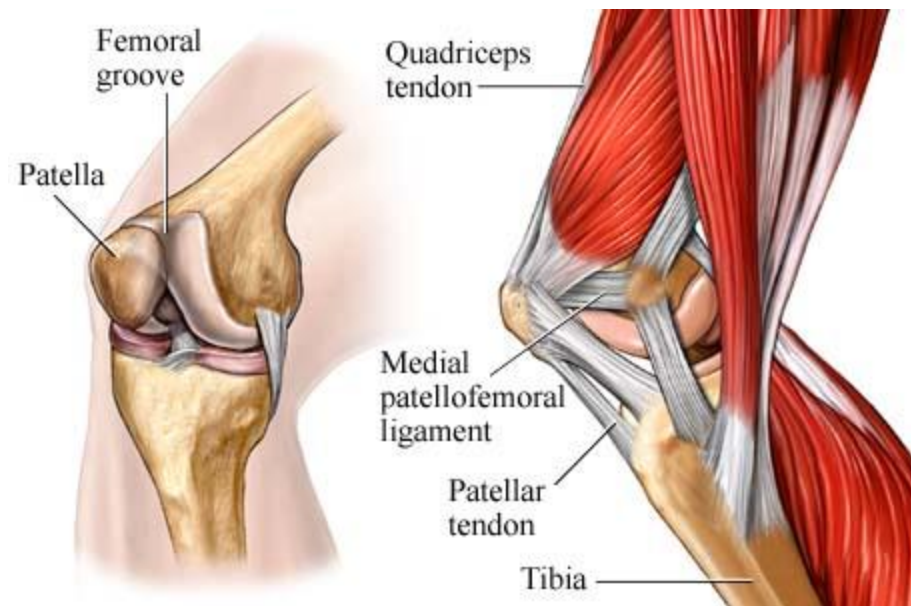
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Internal Knee Anatomy



External Knee Anatomy



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 ossification 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 restarted 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 1st 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

Question 1

- 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

Question 2

- 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

Question 3

- 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

Question 4

- 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

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