2011 Imaging Criteria

Magnetic Resonance Imaging (MRI), Knee (Pediatric)[1, 2]

ICD-9-CM: 88.94
CPT: 73721, 73722, 73723
I/O Setting: Outpatient

INDICATION(S)

100 Acute knee pain secondary to trauma
200 Suspected unstable meniscal tear
300 Suspected stable meniscal tear by Sx/findings
400 Suspected discoid lateral meniscal tear
500 Suspected cruciate ligament injury
600 Suspected multiligamentous injury
700 Suspected LCL/MCL injury with Grade II/III instability of LCL/MCL by PE
800 Knee complaints, unknown etiology
900 Suspected intra-articular loose body
1000 Suspected osteochondritis dissecans
1100 Suspected tumor involving soft tissue
1200 Suspected Baker's cyst
1300 Suspected osteomyelitis

100 Acute knee pain secondary to trauma **[Both]**
- 110 Sx/findings at knee **[Two]**
  - 111 Joint effusion/swelling
  - 112 Limited ROM
  - 113 Acute muscle spasm limiting PE
- 120 No fracture by x-ray

200 Suspected unstable meniscal tear **[One]**[3, 4, 5]
- 210 Knee locking by Hx/PE[6]
- 220 McMurray's test positive[7, 8, 9]

300 Suspected stable meniscal tear by Sx/findings **[Both]**[3, 5, 10*RIN, 11]
- 310 Knee Sx/findings **[Two]**
  - 311 Effusion by PE[12]
  - 312 Joint line tenderness[13]
  - 313 Pain with flexion and rotation[14]
  - 314 Knee giving way by Hx[15]
- 320 Continued Sx/findings **after** Rx **[All]**[16]

321 NSAID **[One]**[17]
-1 Rx ≥ 3 wks
-2 Contraindicated/not tolerated[18]
322 PT ≥ 4 wks[19]
323 Activity modification ≥ 4 wks[20]

400 Suspected discoid lateral meniscal tear **[Both]**[21, 22]
410 Knee Sx/findings **[Two]**
411 Effusion by PE[12]
412 Joint line tenderness[13]
413 Pain with flexion and rotation
414 Clicking
415 Limited ROM
420 Continued Sx/findings **after** Rx **[All]**[16]
421 NSAID **[One]**[17]
-1 Rx ≥ 3 wks
-2 Contraindicated/not tolerated[18]
422 PT ≥ 4 wks[19]
423 Activity modification ≥ 4 wks[20]

500 Suspected cruciate ligament injury **[Both]**
510 Knee giving way by Hx[15]
520 Grade II/III instability of ACL/PCL by PE[23, 24, 25]

600 Suspected multiligamentous injury **[Both]**[26, 27]
610 Grade II/III instability by PE **[One]**[25]
611 LCL[28]
612 MCL[29]
613 Posterolateral complex[30]
620 Grade II/III instability of ACL/PCL by PE[23, 24, 25]

700 Suspected LCL/MCL injury with Grade II/III instability of LCL/MCL by PE[25, 28, 29, 31]

800 Knee complaints, unknown etiology **[All]**[32]
810 Sx/findings **[One]**
811 Joint pain
812 Limited ROM[33]
813 Crepitus[34]
814 Joint line tenderness
815 Effusion by PE[35]
816 Giving way by Hx[15]

820 Knee x-ray nondiagnostic for etiology of Sx/findings[36]
830 Continued Sx/findings **after** Rx **[All]**[37]
831 NSAID **[One]**[17]
-1 Rx ≥ 3 wks
-2 Contraindicated/not tolerated[18]
832 PT ≥ 4 wks[19]
833 Activity modification ≥ 4 wks

900 Suspected intra-articular loose body **[All]**[38]
910 Symptoms at knee **[One]**
911 Joint pain
912 Locking
913 Giving way by Hx
920 Findings at knee **[Two]**
921 Pain with passive ROM
922 Limited ROM
923 Clicking
930 Knee x-ray nondiagnostic for loose body

1000 Suspected osteochondritis dissecans **[All]**[39, 40, 41]
1010 Symptoms at knee **[One]**
1011 Joint pain
1012 Giving way by Hx
1020 Findings at knee **[Two]**
1021 Pain with passive ROM
1022 Limited ROM
1023 Clicking
1024 Effusion by PE
1030 Knee x-ray nondiagnostic for osteochondritis dissecans

1100 Suspected tumor involving soft tissue **[One]**[42]
1110 Bone tumor eroding through cortex by x-ray
1120 Palpable periarticular/intra-articular mass with negative x-ray

1200 Suspected Baker's cyst **[All]**[43, 44]
1210 No locking/giving way by Hx[45]
1220 Findings **[Both]**
1221 Popliteal mass
1222 Knee exam otherwise normal[46]
1230 US nondiagnostic for Baker's cyst[47]
1240 Continued Sx/findings **after** Rx **[Both]**[48]

1241 NSAID **[One]**[17]
-1 Rx ≥ 4 wks
-2 Contraindicated/not tolerated[18]
1242 PT ≥ 6 wks[49]

1300 Suspected osteomyelitis **[Both]**[50]
1310 Findings **[One]**[51, 52, 53]
1311 ESR > 30 mm/hr[54]
1312 Temperature > 100.4 F(38.0 C)
1313 WBC > 10,000/cu.mm($10x10^9$/L)
1314 Blood culture positive
1315 C-reactive protein > 10 mg/L
1320 Knee x-ray nondiagnostic for osteomyelitis

Notes

(1)
MRI has largely replaced arthrogram as a means of nonarthroscopic joint assessment. An arthrogram is an invasive procedure requiring the administration of contrast material to evaluate the joint space and can provide similar information to the MRI for certain indications if read by an experienced radiologist (Firestein and Kelley, Kelley's textbook of rheumatology, 8th ed. 2008, 2 v.). MRI offers the advantages of excellent soft tissue contrast and multiplanar imaging. It does not expose the patient to ionizing radiation and eliminates the need for intra-articular contrast (Crawford et al., Br Med Bull 2007; 84: 5-23).

(2)
The following are examples of relative and absolute contraindications to the use of magnetic resonance imaging:
• Implanted devices that are electrically or magnetically activated (e.g., cardiac pacemakers, automatic cardioverter defibrillators, drug infusion pumps, cochlear implants)
• Ferromagnetic metal objects (e.g., cerebral aneurysm clips, intraocular metallic foreign body, prostheses, screws)
• Pregnancy, first trimester
• Renal insufficiency in cases when magnetic resonance imaging is performed with gadolinium-based contrast

(3)
The medial and lateral menisci are cartilaginous structures that provide internal support to the knee joint. They may be torn when subjected to excessive stress, which can lead to pain, swelling, and in some patients locking and difficulty fully extending the knee.

(4)
Management of meniscal tears depends on whether there is evidence of meniscal instability as documented by locking of the knee or positive provocative testing (e.g., McMurray's test). In these instances, the knee joint itself is stable but part of the torn meniscus is prone to displacement from its normal location.

(5)
Although MRI has a significantly higher specificity for diagnosing medial meniscal tears when compared to clinical exam, it has been argued that MRI does not offer additional diagnostic accuracy compared to clinical exam in evaluating intra-articular knee disorders in children and adolescents and should be used only in select cases (Luhmann et al., J Bone Joint Surg Am 2005; 87(3): 497-502; Kocher et al., Orthop Clin North Am 2003; 34(3): 329-340). A retrospective study in adolescents demonstrated MRI to have a sensitivity and specificity of 92% and 87%, respectively, for detecting a medial meniscal injury and a sensitivity of 93% and specificity of 95% for detecting a lateral meniscal injury. These results are comparable to MRI findings in adults and indicate that MRI of the knee in adolescents can be a useful diagnostic and surgical planning tool (Major et al., AJR Am J Roentgenol 2003; 180(1): 17-19). The sensitivity and specificity of MRI is less in younger children versus older adolescents and this must be considered when MRI is utilized in the evaluation of knee pathology impacting this age group (Kocher et al., Orthop Clin North Am 2003; 34(3): 329-340).

(6)
Locking occurs when the knee becomes "stuck," impeding full extension. True locking of the knee can occur at the time of injury, as the torn portion of the meniscus moves in the area of joint motion. Pseudolocking of the knee occurs soon after an injury due to effusion, pain, and muscle spasm (Marx et al., Rosen's emergency medicine: concepts and clinical practice, 6th ed. 2006). Only 30% of patients with a meniscal tear have true locking (Frontera et al., Essentials of physical medicine and rehabilitation. 2nd ed. 2008). This criteria point addresses patients with both true and pseudolocking of the knee, as well as those with a history of locking.

(7)
A positive response to flexion and rotation testing suggests meniscal injury and can be elicited by a variety of maneuvers, the most common of which are McMurray's test and Apley's test. Additional tests less commonly performed include the Ege and Thessaly test. Results of provocative testing are positive if pain, a palpable snap, or click is elicited. Studies, including 2 meta-analyses conclude that although no single test is 100% diagnostic, a combination of maneuvers as part of a composite PE is likely to be more predictive of a tear (Meserve et al., Clin Rehabil 2008; 22(2): 143-161; Hegedus et al., J Orthop Sports Phys Ther 2007; 37(9): 541-550; Akseki et al., Arthroscopy 2004; 20(9): 951-958).

(8)
A reverse McMurray's test is often performed to diagnose lateral meniscal pathology. The affected knee is rotated internally with pressure over the lateral joint line. Positive results of a reverse McMurray test are equivalent to stating that a patient has a positive McMurray test.

(9)

Studies have concluded that an exam by a well-trained orthopedic examiner that includes provocative flexion and rotation testing is at least as accurate as MRI in diagnosing meniscal and ACL tears (Ryzewicz et al., Clin Orthop Relat Res 2007; 455: 123-133; Mohan and Gosal, Int Orthop 2007; 31(1): 57-60). If clinical findings are positive, and the history and PE suggest concomitant or complex injury, MRI may obviate the need for diagnostic arthroscopy (Rayan et al., Int Orthop 2009; 33(1): 129-132; Kocabey et al., Arthroscopy 2004; 20(7): 696-700).

(10)-RIN:

These criteria exclude patients with meniscal instability documented by locking of the knee or a positive McMurray's test. For patients with these findings, see indication 200 within this criteria subset.

(11)

These criteria address circumstances where a presumptive diagnosis of meniscal tear can be established by the history and PE alone. Non trauma-related meniscal tears can be described as stable depending on location, length, and depth of the tear. Nonoperative treatment is warranted in incomplete tears or small, stable peripheral tears without any associated pathological conditions. These tears have the potential to heal with rehabilitative treatment.

(12)

An effusion involves a fluid collection within the joint space and implies an intra-articular problem. Effusion should be differentiated from nonspecific edema by a careful PE. The onset of knee effusion secondary to a meniscal tear is often delayed, appearing 6 to 12 hours after injury. However, if the tear involves the vascular portion of the meniscus, acute swelling secondary to bleeding (hemarthroses) may develop.

(13)

Joint line tenderness is a common finding in meniscal injuries. Tenderness along the medial joint line suggests a torn medial meniscus, while tenderness at the lateral joint line suggests involvement of the lateral meniscus.

(14)

Pain with flexion and rotation of the knee may suggest a meniscal injury which can be elicited by a variety of maneuvers. The Apley compression and distraction test may help to distinguish meniscal from ligamentous injury. The Apley test is usually performed as an adjunct test. A positive Apley test indicates a probable meniscal tear.

(15)

Reports of the knee "giving way" can indicate serious meniscal or ligament pathology but should be differentiated from knee buckling while standing or going up and down stairs, which suggests muscle weakness. "Giving way" during activities involving knee rotation (e.g., pivoting, turning corners, stepping off a curb) is more consistent with intra-articular derangement (e.g., meniscal injury, ACL or PCL instability) than muscle weakness. Weight-bearing x-rays should be considered to assess for degenerative disease or other pathology as a cause of symptoms.

(16)

Nonoperative treatment is warranted in stable peripheral meniscal tears without additional pathological conditions. These tears have the potential to heal with rehabilitative treatment, thus preserving meniscal tissue and eliminating the need for surgical intervention. Although there is a lack of high-quality randomized trials regarding conservative treatment, current literature suggests that a trial of conservative therapy is beneficial (Englund et al., N Engl J Med 2008; 359(11): 1108-1115; Herrlin et al., Knee Surg Sports Traumatol Arthrosc 2007; 15(4): 393-401).

(17)-POL:

NSAIDs are preferred for the treatment of this condition because of their anti-inflammatory effect. It is a matter of local medical policy whether to accept acetaminophen or other analgesics as alternatives for NSAIDs.

(18)

Contraindications to NSAIDs may be absolute (e.g., pregnancy, history of allergic reaction) or relative (e.g., anticoagulant use, history of PUD).

(19)

PT may be of benefit to patients for reduction of pain and swelling; improvement of ROM and proprioception; and strengthening of quadriceps muscles. Therapy may be by formal supervised PT or provider instruction.

(20)

Activity modification for knee injury involves limiting activities that provoke or aggravate symptoms. These include:

- repetitive or prolonged bending, stooping, squatting, kneeling, pivoting, or twisting the knee, jumping from a height, ascending and descending stairs

- avoiding sports activities such as jogging and those that are stop-and-go (e.g., basketball, racquet sports)
- avoiding walking on slippery or uneven floors or surfaces
- avoiding heavy lifting and carrying

(21)-DEF:
A discoid lateral meniscus is an elongated, thick disc of cartilage which covers most of the articular surface of the tibial plateau. This meniscal variant is less mobile than normal menisci and more prone to tears. Discoid lateral menisci are thought to be congenital anomalies.

(22)
Meniscal injuries are rare in children under the age of ten. The exception to this are those injuries associated with a discoid meniscus (Kocher et al., Orthop Clin North Am 2003; 34(3): 329-340). Classification of a discoid lateral meniscus is based upon the extent that the lateral tibial plateau is covered by the meniscus (i.e., complete, incomplete) or if there is a deficiency in the attachment of the posterior horn of the meniscus (i.e., Wrisberg). There is a 3% to 5% prevalence of this condition in the general population, but a much higher incidence in Asian populations. Discoid lateral menisci occur bilaterally in 20% of cases (Youm and Chen, Am J Orthop 2004; 33(5): 234-238; Kocher et al., Orthop Clin North Am 2003; 34(3): 329-340). Partial meniscectomy is the treatment of choice when complete and incomplete discoid lateral menisci are symptomatic, generally due to a tear. Total meniscectomy or meniscal repair are surgical options for a patient with an unstable Wrisberg discoid lateral meniscus (Youm and Chen, Am J Orthop 2004; 33(5): 234-238).

(23)
The ACL provides knee stability against anterior tibial translation (forward gliding motion in relation to the femur). The Lachman test, the pivot shift test, and the anterior drawer test assess for anterior tibial translation by manually stressing the knee and are the primary diagnostic tests used to evaluate the integrity of the ACL. Two meta-analyses found the Lachman test to have the highest sensitivity, specificity, and negative predictive value, the pivot shift test to have the highest positive predictive value, and the anterior drawer test to have the lowest sensitivity and specificity of these 3 tests. Based on these analyses, there is a high probability of an ACL rupture with a positive pivot shift test and a high probability of no rupture with a negative Lachman test (Benjaminse et al., J Orthop Sports Phys Ther 2006; 36(5): 267-288; Scholten et al., J Fam Pract 2003; 52(9): 689-694). Further research regarding the accuracy of these diagnostic tests, especially in a primary care setting, would be of benefit since these meta-analyses had some identified bias, included some mixed methodologies and heterogeneous data, and consequently may have overestimated the accuracy of the diagnostic tests.

(24)
The PCL provides knee stability against posterior tibial translation (rearward gliding motion in relation to the femur). With a sensitivity of 90% and a specificity of 99%, the posterior drawer test is the most sensitive and specific test for PCL injuries (Brown and Trojian, Prim Care 2004; 31(4): 925-956). This test involves placing the knee in 90 degrees of flexion and assessing the amount and quality of posterior translation when manually stressed (Rooks and Corwell, Prim Care 2006; 33(3): 751-777, viii).

(25)
Ligamentous injuries are classified according to the amount of instability (laxity) demonstrated on PE when the joint is subjected to stress. Standard grades are as follows:
- **Grade I:** Pain without instability
- **Grade II:** Instability with a palpable endpoint
- **Grade III:** Instability without a palpable endpoint

Grade I represents microscopic injury as a result of the over stretching of a ligament. Partial tears present with Grade II instability, whereas complete ligamentous tears present with Grade III instability.

(26)
Multiligamentous knee injuries are complex injuries and are associated with significant functional instability. These injuries are potentially complicated by fractures, intra-articular chondral and meniscal damage, neurovascular compromise, and soft tissue damage. These injuries require an aggressive approach to treatment, which typically involves surgery (Fanelli et al., Arthroscopy 2005; 21(4): 471-486; Kaeding et al., Arthroscopy 2005; 21(4): 424-430).

(27)
MRI is beneficial in identifying the presence of ligamentous injury and may be helpful in confirming a finding on PE or when the examination is equivocal (Pimentel, Med Clin North Am 2006; 90(2): 355-382; Quarles and Hosey, Prim Care 2004; 31(4): 957-975, ix). Its ability to localize and characterize the ligamentous injury and identify associated meniscal or osteochondral damage aids in surgical planning (Theodorou et al., Acta Radiol 2005; 46(3): 297-305).

(28)-DEF:
The LCL provides knee stability against varus stress. The evaluation of the LCL involves assessment of knee laxity with the application of a varus stress in both extension and flexion.

(29)-DEF:
The MCL provides knee stability against valgus stress, and also contributes to the restraint of anterior tibial translation. The evaluation of the MCL involves assessment of knee laxity with the application of valgus stress. MCL and LCL injuries are rare in children because the physis gives way first.

(30)-DEF:
A posterolateral complex injury damages the region of the knee joint, which is comprised of the iliotibial band, biceps femoris tendon, quadriceps retinaculum, lateral patellofemoral ligament, popliteofibular ligament, popliteus muscle and tendon, arcuate ligament complex, and the lateral capsular ligament. A posterolateral corner injury refers to the entire posterolateral complex in addition to the LCL (Quarles and Hosey, Prim Care 2004; 31(4): 957-975, ix).

(31)
Patients with isolated LCL or MCL injuries, even severe tears, are often effectively treated without surgery. Management typically involves brief immobilization followed by an aggressive rehabilitation program that incorporates an external joint support. Most patients treated in this manner will successfully return to full function within 6 to 8 weeks.

(32)
These criteria cover patients with nonspecific clinical findings. MRI is performed to aid in the diagnosis of the knee pain.
MRI has a very high negative predictive value; if MRI findings are normal, there is ≥ 90% chance that the joint at arthroscopy or open surgery will be normal (Carrino and Schweitzer, Radiol Clin North Am 2002; 40(2): 181-202).

(33)
Limited ROM can be due to effusion or pain and is often described by the patient as knee "stiffness".

(34)-DEF:
Crepitus is a sometimes audible, or sometimes palpable, grating sensation caused by two irregular cartilage surfaces moving relative to each other. It can be appreciated when the joint is extended or flexed.

(35)
Effusion involves a fluid collection within the joint space and implies an intra-articular problem. Effusion should be differentiated from nonspecific edema (i.e., extra-articular fluid) by a careful PE.

(36)
X-ray should be performed to exclude fracture, dislocation, or tumor as possible causes of the patient's symptoms.

(37)
The listed treatments may have occurred at any time in the course of the illness. External joint support is important adjunctive therapy in most cases. Canes, crutches, or walkers can be used to decrease load and allow healing. Immobilization can provide rest to the joint using various immobilization devices (e.g., Jones dressing, splints, knee immobilizers).

(38)
Loose bodies in synovial joints are formed by several mechanisms, including trauma with fracture, joint disintegration from degeneration, and synovial proliferation. Examples of loose bodies include osteochondritis dissecans fragments, chondral fragments, and calcified loose bodies. Loose bodies that are stable or attached to a synovial membrane, recess, or bursa tend to be asymptomatic and can be treated conservatively. Loose bodies that move within the joint cavity can become trapped between the articular surfaces causing pain, limited motion, locking, and effusion (Dubberley et al., J Bone Joint Surg Br 2005; 87(5): 684-686).

(39)
Osteochondritis dissecans (OCD) of the knee is an acquired condition that results in the complete or incomplete separation of a portion of joint cartilage and subchondral bone from the underlying bone (Bruce et al., Prim Care 2005; 32(1): 253-276; Wall and Von Stein, Orthop Clin North Am 2003; 34(3): 341-353). OCD has two forms: juvenile (occurring in individuals with open growth plates) and adult (which begins after the growth plates have closed) (Crawford and Safran, J Am Acad Orthop Surg 2006; 14(2): 90-100). The exact etiology is unknown, but trauma, ischemia, and genetics are thought to be factors in this condition (Bruce et al., Prim Care 2005; 32(1): 253-276).

(40)
MRI may assist in differentiating irregular ossification, a benign normal variant of ossification, from juvenile osteochondritis dissecans (Wall and Von Stein, Orthop Clin North Am 2003; 34(3): 341-353).

(41)
MRI plays a critical role in evaluating the stability of the osteochondritis dissecans lesion, determining an appropriate treatment plan (e.g., conservative versus surgical), and assessing healing (Crawford and Safran, J Am Acad Orthop Surg 2006; 14(2): 90-100; Wall and Von Stein, Orthop Clin North Am 2003; 34(3): 341-353).

(42)
MRI is performed to define the presence and extent of soft tissue involvement, as well as any bone marrow involvement (Balassy and Hormann, Eur J Radiol 2008; 68(2): 245-258).

(43)-DEF:
A popliteal cyst, also known as a Baker's cyst, is a cyst in the popliteal fossa on the posteromedial aspect of the knee between the medial head of the gastrocnemius muscle and the semimembranous tendon. It results from synovitis causing enlargement of the gastrocnemius-soleus bursa.

(44)
A Baker's cyst is commonly seen during middle childhood and presents as a painless, asymptomatic mass. In children spontaneous resolution usually occurs over the course of 12 to 24 months. Therefore, once the diagnosis has been confirmed the treatment of choice is observation with surgical excision generally reserved for symptomatic cases or cases of progressive enlargement (Kliegman and Nelson, Nelson textbook of pediatrics, 18th ed. 2007, lii, 3147 p.; Kocher et al., Orthop Clin North Am 2003; 34(3): 329-340).

(45)
Locking or giving way would indicate intra-articular knee disease.

(46)
If the knee exam is abnormal, evaluation should be directed to the primary knee pathology rather than the Baker's cyst.

(47)
In the majority of cases, US is a sensitive, noninvasive, cost-effective, and reliable imaging technique for diagnosing Baker's cyst and to exclude DVT or popliteal aneurysm (Blankenbaker and De Smet, Clin Sports Med 2006; 25(4): 867-897). MRI may be done if the US is nondiagnostic to identify degenerative disorders, ligament pathology, internal derangement, and vascular tumors (Beaman and Peterson, Radiol Clin North Am 2007; 45(6): 969-982, vi).

(48)
If the Baker's cyst interferes with ADLs or is enlarging by exam, conservative therapy may not be appropriate. This is a matter of clinical judgment.

(49)
PT is useful for many patients for reduction of pain and swelling and improvement of ROM. PT can be in a supervised or home therapy program.

(50)
In the pediatric population, osteosarcoma and Ewing sarcoma are the most frequently occurring malignancies of bone and early symptoms may mimic those of osteomyelitis. MRI in concert with laboratory testing can assist in a differential diagnosis (Balassy and Hormann, Eur J Radiol 2008; 68(2): 245-258).

(51)
The clinical presentation of osteomyelitis is age dependent and early in the course of the infection signs and symptoms are frequently subtle. In the neonate, pseudoparalysis, pain with motion or tenderness by palpation of the affected site may be present, although some neonates neither appear ill nor have a fever. Pain, fever, irritability, erythema, warmth, and limping or refusal to bear weight may be found in toddlers and children. Fever and pain are the most common complaints given by older children and adolescents with osteomyelitis (Frank et al., Pediatr Clin North Am 2005; 52(4): 1083-1106, ix; Kliegman and Nelson, Nelson textbook of pediatrics, 18th ed. 2007, lii, 3147 p.).

(52)
If the patient is immunocompromised, fever may not be present and the WBC may be unchanged or low.

(53)
MRI is the preferred imaging choice as it is able to distinguish soft tissue changes, and the extent of bone marrow and joint involvement (Balassy and Hormann, Eur J Radiol 2008; 68(2): 245-258).

(54)
In acute cases of osteomyelitis, the ESR levels may be normal during the first few days of infection (Kliegman and Nelson, Nelson textbook of pediatrics, 18th ed. 2007, lii, 3147 p.).