BMJ Best Practice

Medial collateral ligament injury

Straight to the point of care

Last updated: Jun 02, 2023

Table of Contents

Summary

Medial collateral ligament injury occurs when excessive valgus stresses or external rotation forces are placed on the knee joint.

The most common symptom is medial-sided knee pain above or below the joint line. Patients are usually able to walk.

Diagnosis and grading is primarily made with history-taking and physical examination.

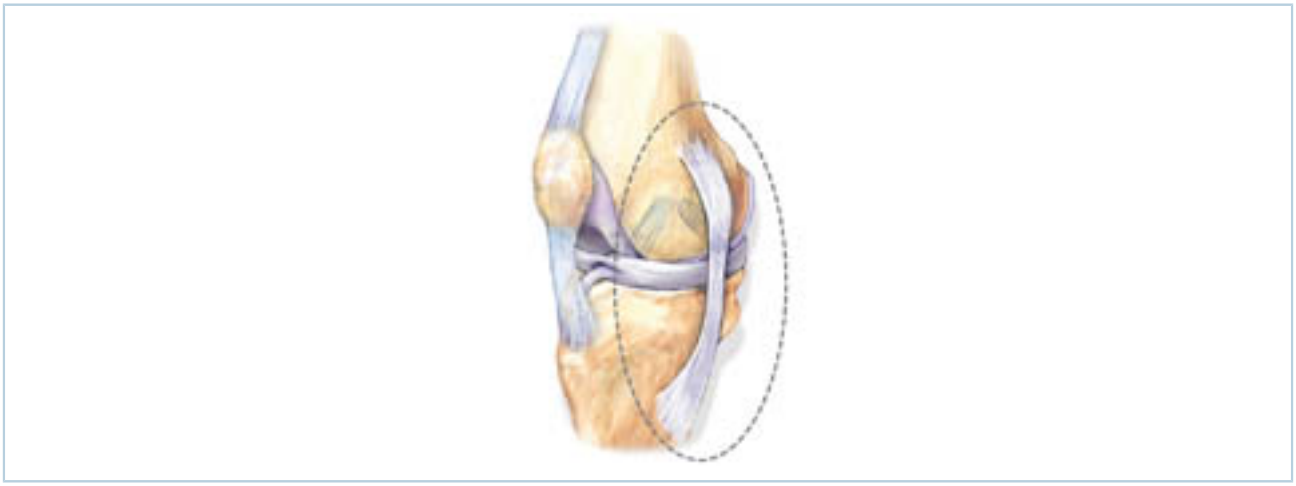
Most patients are treated non-operatively.

Prognosis for isolated medial collateral ligament injuries is good. Most patients return to sports within 3 to 6 weeks and to pre-injury levels within 3 months.

Combined multi-ligament and chronic medial collateral ligament injuries often require operative intervention.

Definition

The medial collateral ligament (MCL) is a supporting structure on the medial part of the knee joint.



Medial collateral ligament (right knee)

Created by Sanjeev Bhatia, MD; used with permission

Its primary function is to resist valgus (twisting outwards away from the mid-line) and external rotation forces of the tibia in relation to the femur. The mechanism for MCL injury is typically a large valgus and/or external rotation force that is suddenly placed on the knee joint. Injuries to the MCL range in severity from a few torn fibres to complete disunity of the ligament.

Epidemiology

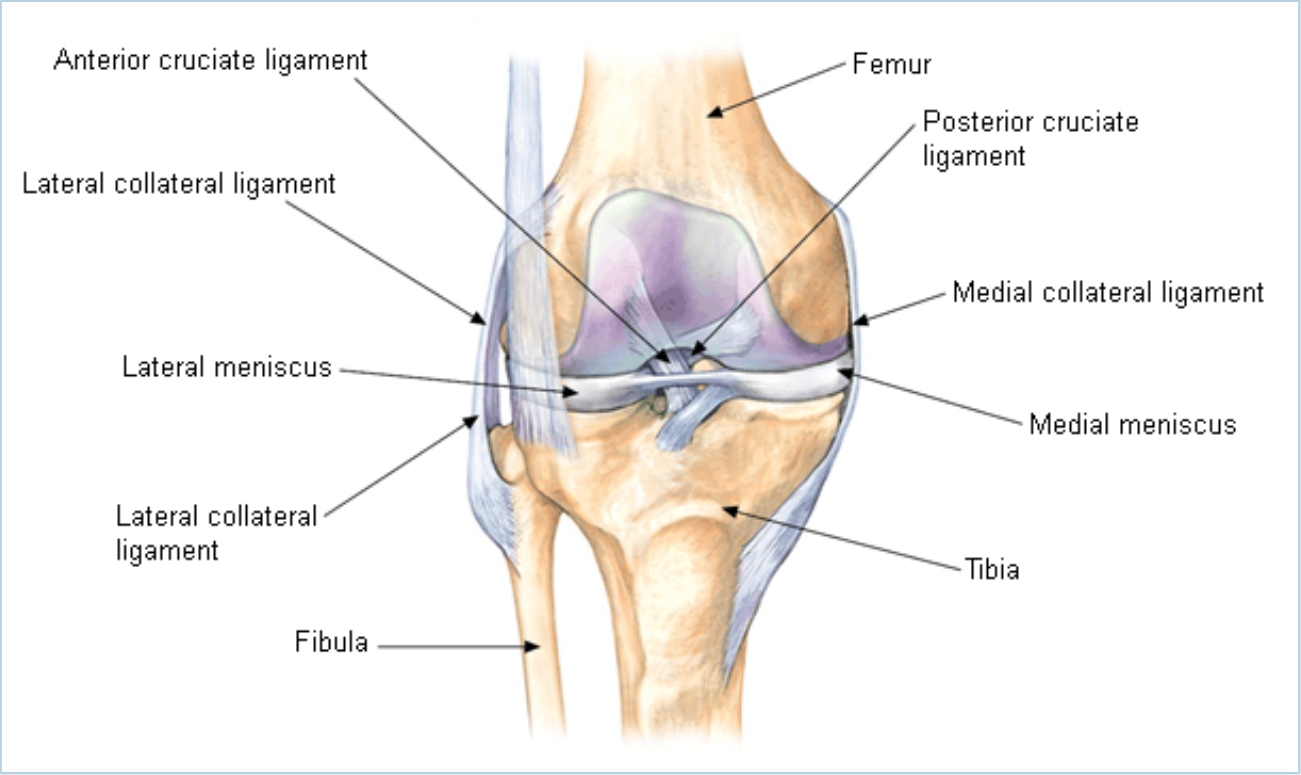
The true incidence of MCL injuries is difficult to ascertain because of the wide variation in injury severity. Minor MCL injuries are often never evaluated by a physician. However, injury to the MCL is one of the most common injuries of the knee.[8] [9] MCL injury is equally observed in men and women. Due to an age-associated decline in ligament elasticity, adults are more susceptible to MCL injury than children or adolescents. Because MCL injuries are usually related to athletic endeavours, peak incidence occurs in those more likely to engage in these pursuits. Typically this means adults aged 20 to 35 years. Nonetheless, MCL injuries are also observed in older people due to falls. The incidence of MCL injury is highest in sports such as American football (55%),[10] skiing (15% to 20% of all injuries and 60% of all knee injuries),[11] and rugby (29%),[12] where valgus (twisting outwards away from the mid-line) and external rotational forces on the knee are commonly experienced. MCL injuries can also occur in non-contact sports. Finally, the MCL may be injured in conjunction with the anterior cruciate ligament, posterior cruciate ligament, meniscus, bone, and/or lateral complex.[9]

Aetiology

MCL injuries require that a valgus (twisting outwards away from mid-line) and/or external rotation load be placed on the knee. Valgus loads can occur through contact, non-contact, and over-use mechanisms.[9] Contact mechanisms, commonly associated with a blow to the lateral knee, involve large valgus stresses and often result in a complete MCL tear. Non-contact valgus and external rotational stresses, observed in cutting, pivoting, and deceleration motions of the leg (e.g., skiing), frequently cause partial tears of the MCL. Finally, over-use mechanisms may be observed in sports such as swimming (breaststroke whip kick) and gymnastics, which place repetitive valgus loads across the knee joint.[13]

Pathophysiology

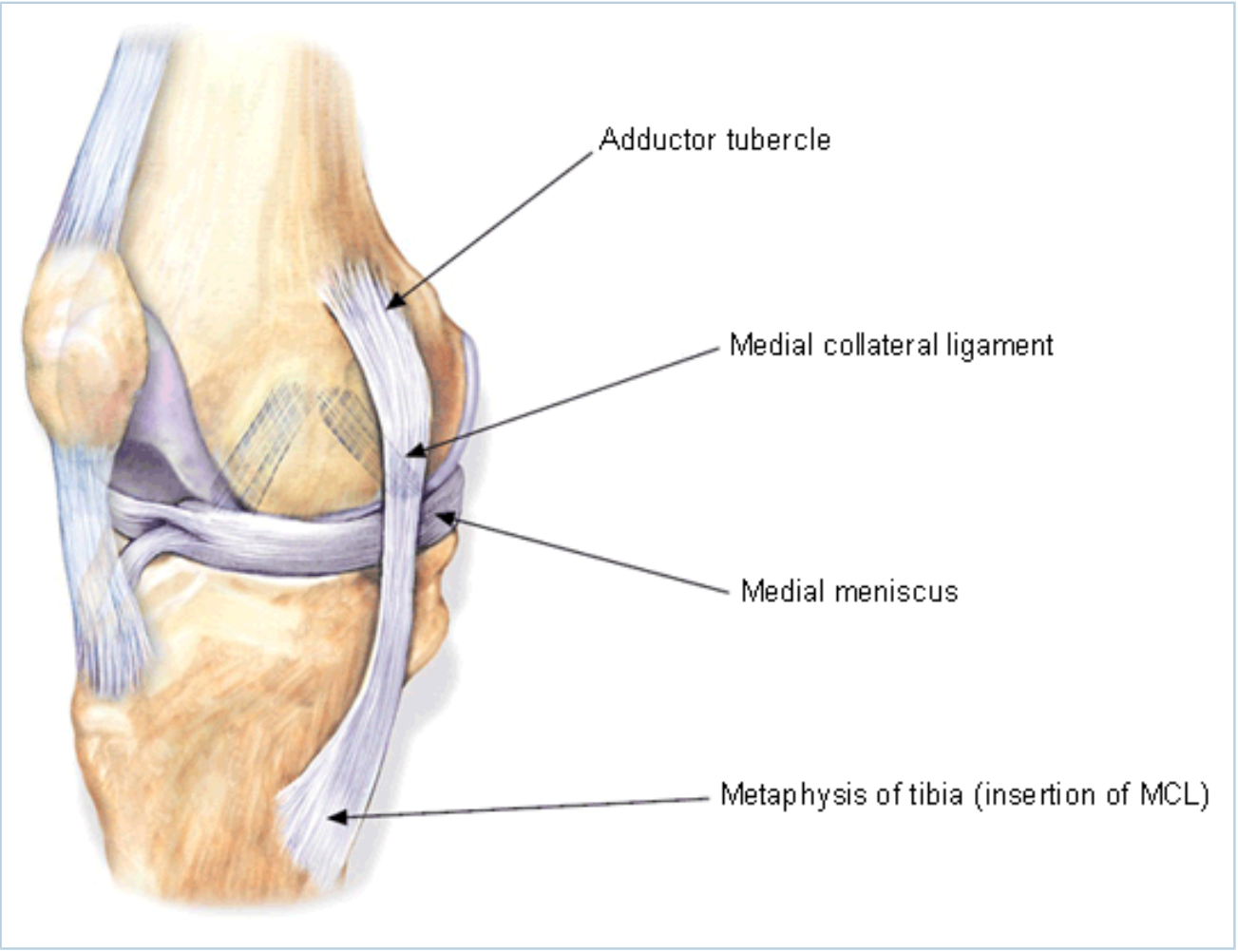
Anatomically, the MCL is composed of a superficial and a deep portion. The superficial MCL resides in the middle layer of the medial compartment of the knee and spans from the medial femoral condyle to its broad insertion at the metaphysis of the tibia, 4 to 5 cm below the joint line.



Anterior knee anatomy (right knee), patella removed

Created by Sanjeev Bhatia, MD; used with permission

THEORY



Oblique view of medial knee (right knee). MCL: medial collateral ligament

Created by Sanjeev Bhatia, MD; used with permission

It is the principal restraint to valgus forces at the knee joint at all degrees of flexion. The deep MCL resides in the third layer of the medial compartment and is often separated from the superficial MCL by a bursa, which facilitates sliding of the two MCL components during flexion. The deep MCL attaches to the medial meniscus but does not aid in resisting valgus stress on the knee.

The severity of MCL injury is proportionally related to the number of ligament fibres torn in the superficial MCL. The most common location for MCL injuries is the femoral insertion.[13] Grade I injuries consist of a minimal number of torn fibres, grade II injuries have an increased degree of ligamentous disruption, and grade III injuries result in complete tearing of MCL fibres. Paradoxically, higher-grade MCL injuries are usually associated with less pain, perhaps because there is little or no tension on the injured ligament.[13] Patients with MCL injuries repeatedly experience a sense of valgus instability and altered biomechanics leading to post-traumatic arthrosis. Healing of grade I and II MCL injuries usually follows a relatively predictable sequence: haemorrhage, inflammation, proliferation, and re-modelling.[14]

Patients frequently have concomitant injury to the anterior cruciate ligament, posterior cruciate ligament, and meniscus. See Anterior cruciate ligament (Diagnostic approach) and Meniscal tear (Diagnostic approach) .

In knee injuries from cutting manoeuvres (occurring when an athlete forcefully changes direction on a weight-bearing foot), valgus forces placed on the knee usually tear the medial capsular ligament first, then the MCL,

and finally the anterior cruciate ligament.[15] Because the meniscus is firmly attached to the deep MCL, meniscal tears commonly present alongside MCL tears.

Classification

O'Donoghue classification[1]

Isolated grade I MCL injury (mild)

- MCL has a few torn fibres but there is no loss of ligamentous integrity.

Isolated grade II MCL injury (moderate)

- MCL is partially torn. However, the fibres are still opposed. There might be mild pathological laxity, which may or may not be symptomatic.

Isolated grade III MCL injury (severe)

- Integrity of the MCL is completely disrupted. There is significant pathological laxity of the knee with valgus stress.

American Medical Association Committee on the Medical Aspects of Sports standard nomenclature of athletic injuries[2]

MCL injuries are classified based on the amount of medial joint opening when a valgus load is applied at 20 to 30 degrees of knee flexion:

The abduction (valgus) stress test

From the collection of Sanjeev Bhatia, MD; used with permission

- Grade I: 0 to 5 mm of opening
- Grade II: 5 to 10 mm of opening
- Grade III: >10 mm of opening

Proposed classification, based on MRI findings:[3]

Type 1: Pre-avulsion injury

Type 2: Avulsion injury

Type 3: MCL injury

Type 4: Distal rupture of the MCL and bone contusion

Other forms of MCL injury

MCL + anterior cruciate ligament (ACL) injury

- The ACL is the most commonly injured ligament along with the MCL.

MCL + multiligament injury

- The posterior cruciate ligament, lateral collateral ligament, and menisci are frequently simultaneously injured.

Recurring MCL injury

- Recurring, or chronic, MCL injury is a complication of acute MCL injury.

Case history

Case history #1

A 21-year-old rugby player was tackled on the lateral side of his left lower thigh. During the course of the tackle, the player felt a tearing sensation on the medial part of his knee that was associated with excruciating pain. Immediately after the play, he was unable to get up or walk. On physical examination, there is significant tenderness of the adductor tubercle and joint line. Valgus stress testing (abduction stress test) demonstrates some medial instability at 30 degrees of knee flexion, but with a firm endpoint (i.e., resistance is felt). Anterior drawer test and Lachman's test are negative.

The abduction (valgus) stress test

From the collection of Sanjeev Bhatia, MD; used with permission

The anterior drawer test

From the collection of Sanjeev Bhatia, MD; used with permission

THEORY

The Lachman's test

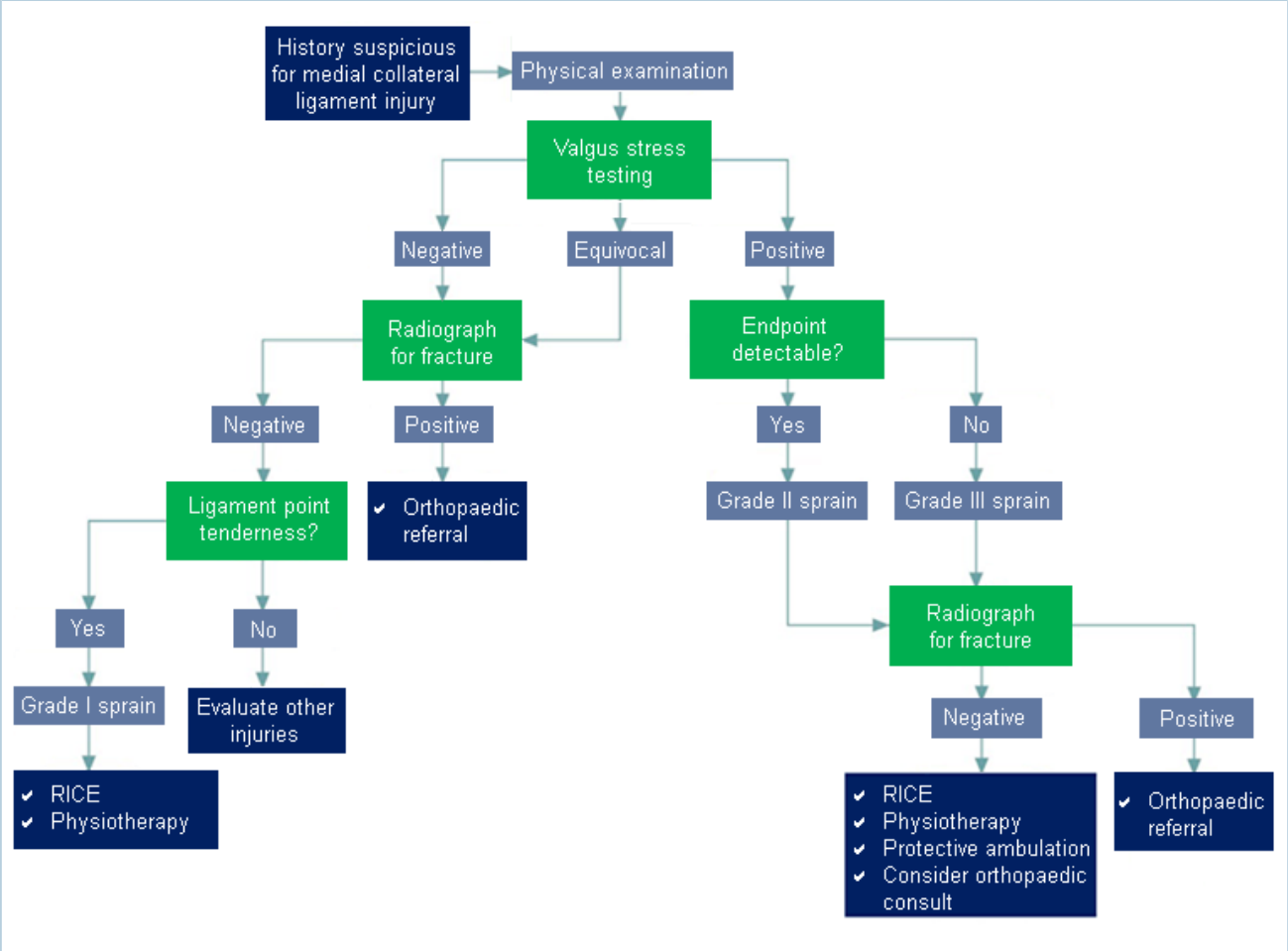
From the collection of Sanjeev Bhatia, MD; used with permission

Other presentations

Although rare, it is possible for a patient who has had an acute MCL injury to develop chronic valgus (twisting outwards away from the mid-line) instability. Chronic MCL injury is usually defined as symptoms that persist for 3 months or longer after injury.[4] By this point, injured ligament tissue is beyond its capacity to heal, and anatomical restoration is usually no longer possible due to scar tissue formation and contractures of ligament ends. When combined with anterior cruciate ligament deficiency, chronic MCL injury has been shown to seriously compromise joint stability, and these patients frequently experience symptoms of their knees giving way.[5] [6] [7]

Approach

Characteristic history and physical examination findings are usually sufficient for diagnosis and grading of injury. Radiography and magnetic resonance imaging (MRI) are useful for identifying concomitant knee pathology and the location of ligament injury.



Diagnostic algorithm for medial collateral ligament injuries. RICE: rest, ice, compression, elevation

Created by Sanjeev Bhatia, MD; used with permission

History

The precise mechanism of injury is established because determining the vector of force during injury helps to identify the likely site of pathology. Excessive valgus stress on the knee is the most common mechanism for medial collateral ligament (MCL) injury. Often this valgus load results from a contact force on the lateral aspect of the lower thigh (e.g., during a tackle in sports such as American football or rugby). Non-contact valgus stress injuries are also common in sports such as skiing and are often combined with an external rotational element. The knee is frequently partly flexed at the time of injury.

Additional information that is important to obtain from the history includes the timeframe of injury, location of pain and tenderness, ability to ambulate after injury, any sensation of a pop or a tear (may indicate a more serious injury), time and onset of knee swelling, and presence of a deformity.[19] A common feature of MCL injuries is pain and stiffness on the medial side of the knee; patients with less severe injuries can typically still mobilise and do not have mechanical symptoms such as locking. Most low-grade MCL injuries are not associated with knee swelling. The timeframe of injury helps to distinguish acute

from chronic injury (chronic is defined as MCL injury ≥3 months from initial injury event).[4] Pain and tenderness usually corresponds to the site of knee pathology.[15]

Concurrent injuries commonly include bone bruises, anterior cruciate ligament (ACL) tears, lateral collateral ligament tears, medial meniscus tears, lateral meniscus tears, and posterior cruciate ligament (PCL) tears.[20] Questioning should explore the presence of mechanical symptoms, such as knee locking or giving way, which can help in the diagnosis of concomitant meniscal or other ligament pathology.

Physical examination

The goal of the physical examination is to confirm MCL injury, assess severity, and diagnose associated injuries. [Knee exam (9 of 27): inspection & palpation: supine] (https://www.youtube.com/watch?v=ONA_y0znCoU) The injured knee should first be inspected and palpated in a systematic manner. [Knee exam (14 of 27): MCL] (https://www.youtube.com/watch?v=NMi2RsAohSw) The presence and location of point tenderness, knee effusion or localised soft-tissue swelling, deformity, and/or ecchymosis should be noted. Time elapsed from injury to onset of swelling provides clues to the pathology involved: an acute effusion, occurring within 2 hours of injury, suggests haemarthrosis; swelling 12 to 24 hours after injury usually indicates a synovial effusion.[18] The presence of haemarthrosis is suspicious for an ACL injury. The site of injury along the superficial MCL usually correlates closely with the location of oedema and tenderness.[15]

The integrity of the MCL is evaluated by assessing medial instability with the abduction stress test. The injured knee is flexed to 30 degrees and, with the knee stabilised, the ankle is gently abducted.

The abduction (valgus) stress test

From the collection of Sanjeev Bhatia, MD; used with permission

The degree of laxity (in mm) and the quality of the end point should be noted. A firm end point (i.e., resistance is felt) indicates an intact MCL; a torn ligament is associated with a soft end point. The findings from the injured knee should be compared with the uninjured knee as a control. If the injured knee abducts more than the uninjured knee, the test is positive. MCL injuries are classified based on the amount of medial joint opening when a valgus load is applied at 20 to 30 degrees of knee flexion:[2]

- Grade I: 0 to 5 mm of opening
- Grade II: 5 to 10 mm of opening
- Grade III: >10 mm of opening

The examination is then repeated in full extension to recruit contributions of posteromedial structures. A positive abduction stress test in full leg extension is highly suspicious for an ACL or PCL injury. The patient's feet should be maintained in the same degree of external rotation as was used during the flexed abduction stress testing in order to reduce false-positive results.

Tests should also be performed to rule out concomitant knee pathology.

- The anterior drawer test is the most reliable method for evaluating anteromedial rotatory instability, which can be present with or without an associated ACL injury.[21] This test is performed with the foot in external rotation and knee flexed at 90 degrees. Any laxity seen with an anterior pull on the proximal calf is positive for anteromedial instability, usually brought on with damage to the posterior oblique portion of the MCL.

The anterior drawer test

From the collection of Sanjeev Bhatia, MD; used with permission

- The posterior drawer test, performed the same way but with a push on the tibia, is sensitive for PCL injury.
- The Lachman's test is good for evaluating the ACL, even if the MCL has also been injured.[22] The knee is put in 20 to 30 degrees of flexion. The clinician uses one hand to hold the lower thigh above the knee and the other hand holds around the upper tibia (with the thumb on the tibial tuberosity). The tibia is then pulled anteriorly. An intact ACL will give a firm end point, preventing any forward translation. A torn ACL will demonstrate a soft end point by allowing more than 2 mm of anterior translation, as compared with the contralateral knee.

The Lachman's test

From the collection of Sanjeev Bhatia, MD; used with permission

- The pivot shift test can also be used for diagnosing an ACL tear. Internal rotation and valgus stress is applied on the knee while taking it from 20 to 40 degrees of flexion. In an ACL-deficient knee, the tibia anterolaterally subluxes in the initial phase of flexion and then reduces with further flexion. Tenderness on the joint line suggests meniscal injury.

Early referral to an orthopaedic specialist is recommended for grade III MCL tears, a positive anterior drawer test, suspected multi-ligament injury, meniscal pathology, fractures, or any difficulty with diagnosis.

Diagnostic tests

- Plain x-rays of the knee are ordered according to the Ottawa knee rules. Any one of the listed indications is sufficient to order an x-ray.

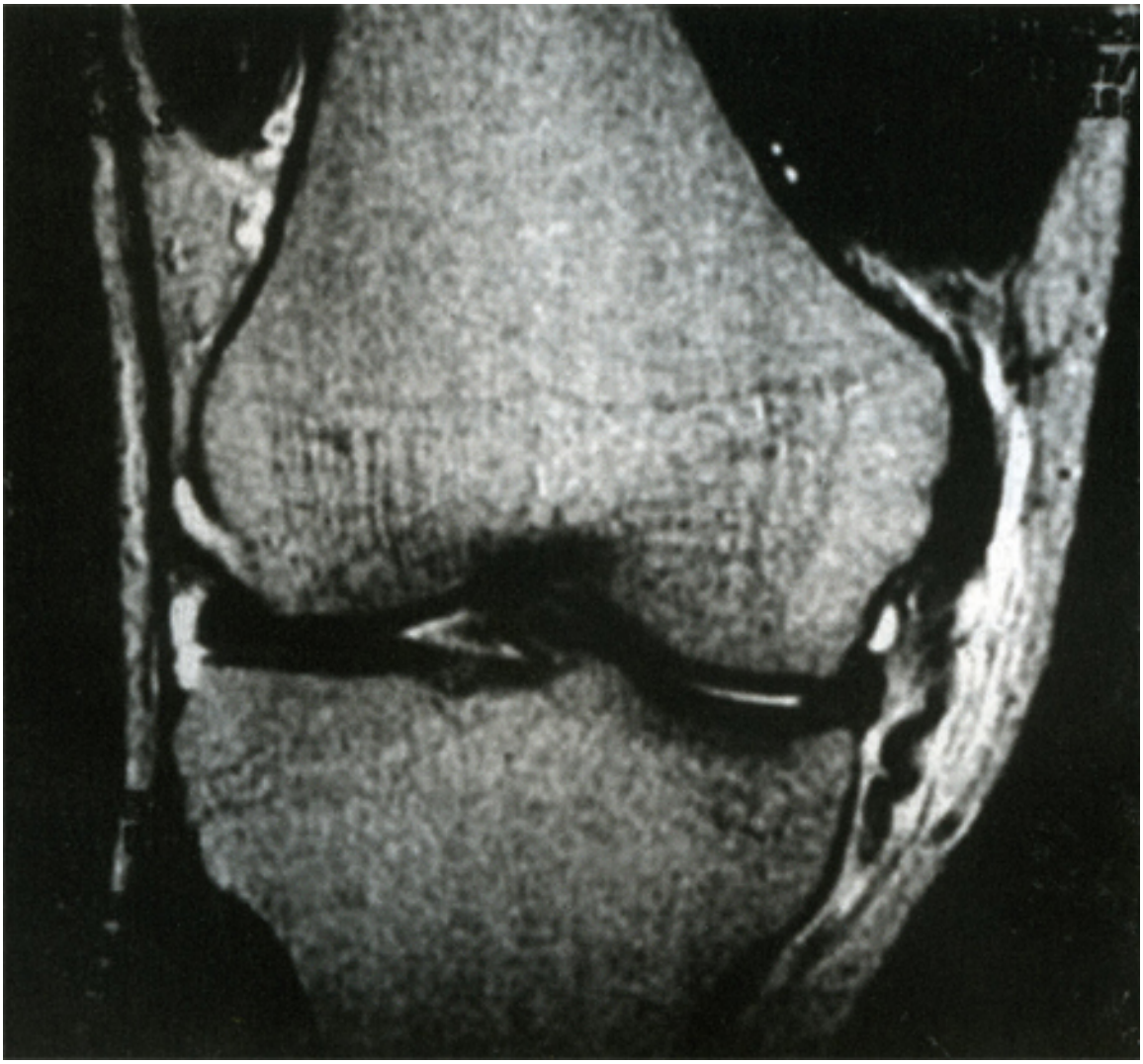
Knee x-ray indications: Ottawa knee rules (acute)
• Age ≥55 years • Isolated patella tenderness • Tenderness at head of fibula • Inability to flex knee 90° • Inability to bear weight (4 steps) immediately after injury and in emergency department

X-ray indications in acute knee injury: the Ottawa knee rules

Table created by Sanjeev Bhatia, MD. Adapted from Stiell IG, et al. Implementation of the Ottawa knee rule for the use of radiography in acute knee injuries. JAMA. 1997;278:2075-2079

Stress radiography, with a valgus stress placed on the knee at 15 to 20 degrees of flexion, is not routinely used for diagnosis or grading of injury as the diagnostic yield in grade I and II injuries is low. However, with grade III injuries in adolescents, stress radiography may help to visualise the opening on the medial side of the joint and should be ordered in these patients as these x-rays can also help rule out physeal injury in this age group. Stress radiography is also useful in adults to help identify a grade III injury. A grade III MCL injury should be suspected in situations in which valgus stress radiography demonstrates a greater than 3.2 mm side-to-side difference of medial compartment gapping when comparing the non-injured knee to the injured knee at 20 degrees of flexion.[23] Radiography also identifies fractures of the tibial plateau, patella, or distal femur.

- MRI provides excellent visualisation of soft tissue anatomy and is indicated if injury to the menisci, ACL, or PCL is suspected. MRI can also indicate the presence of bone bruises or osteochondral fractures. MRI is useful for identifying the site of an MCL tear, but is not an accurate method for determining grade of injury.



T2-weighted MRI showing a medial collateral ligament injury

From the collection of Sanjeev Bhatia, MD; used with permission

- Diagnostic ultrasound can also be used to evaluate soft tissue knee injuries, although MRI currently remains a more reliably accurate diagnostic modality.[24] [25]

History and exam

Key diagnostic factors

presence of risk factors (common)

- Risk factors include participation in activities involving valgus stress at the knee joint, age 20 to 35 years (most likely to engage in high-risk athletic pursuits), and age 55 to 70 years (more prone to MCL injuries during falls).

injury due to excessive or repetitive valgus loading of MCL (common)

- Lower-grade MCL injuries frequently occur with non-contact valgus and external rotation injuries (e.g., twisting injuries during skiing accidents).
- More severe injuries are usually associated with a blow to the lateral side of the knee.

medial knee pain (common)

- MCL injury is associated with pain on the medial side of the knee along the length of the ligament, both above and below the joint line.
- Paradoxically, higher-grade MCL injuries are usually associated with less pain, perhaps because there is little or no tension on the injured ligament.[15]

joint effusion (common)

- The location of joint effusion has been shown to correlate with the injury site in the superficial MCL 64% of the time.[15]
- Absence of joint effusion may indicate a severe tear: grade III injuries result in tearing of the joint capsule, allowing fluid to escape to surrounding soft tissues.
- Speed of onset of swelling provides clues to the pathology involved. An acute effusion, within 2 hours of injury, suggests haemarthrosis. Swelling 12 to 24 hours after injury usually indicates a synovial effusion.[18]
- Haemarthrosis, while uncommon, is suspicious for injury to the anterior cruciate ligament.

tenderness (common)

- Usually occurs at the adductor tubercle or proximal tibia. In 76% of cases, the site of tenderness corresponds with the site of injury in the superficial MCL.[15] Medial meniscal tears have tenderness limited to the joint line.

laxity on valgus stress testing (common)

- The abduction stress test (i.e., applying a valgus load to the knee) at 30 degrees flexion is an excellent diagnostic tool.

The abduction (valgus) stress test

From the collection of Sanjeev Bhatia, MD; used with permission

Pain and disproportionate laxity imply stretching or tearing of the MCL.

- Pain and laxity with valgus stress in a fully extended knee suggest coexistent anterior cruciate ligament tear.[18]

Other diagnostic factors

ecchymosis (common)

- Ecchymosis over the MCL often develops 1 to 3 days after injury.

audible pop or tearing sensation at time of injury (uncommon)

- Suggests grade III MCL injury or cruciate ligament injury.

difficulty walking (uncommon)

- Most patients are able to continue walking after an acute injury. In one study, even with grade III MCL injuries, 76% of patients were able to walk into a surgery unaided by external support.[15]

instability symptoms of knee (uncommon)

- Most MCL injuries are not associated with instability symptoms ("giving way"). The rare exception is injury to the posterior oblique portion of the deep MCL, which can result in anteromedial instability.
- If instability is a prominent feature, anterior cruciate ligament or posterior cruciate ligament injury is likely.

mechanical knee symptoms (uncommon)

- Symptoms such as catching, locking, giving way, and popping are not usually associated with MCL injuries. Concomitant meniscal tear or cruciate ligament injury should be suspected.

knee deformity (uncommon)

- May signify patellar subluxation or dislocation.

positive anterior drawer test (uncommon)

- Test is performed with the foot in external rotation and knee flexed at 90 degrees.
- Any anteromedial instability evident during test

The anterior drawer test

From the collection of Sanjeev Bhatia, MD; used with permission

suggests that the deep MCL may be damaged, specifically the posterior oblique portion.

positive posterior drawer test (uncommon)

- Test is performed the same way as an anterior drawer test but with a push on the tibia.
- Any laxity indicates injury to the posterior cruciate ligament.

positive Lachman's test (uncommon)

- The best diagnostic test for anterior cruciate ligament (ACL) injury.

The Lachman's test

From the collection of Sanjeev Bhatia, MD; used with permission

- The patient's knee is put in 20 to 30 degrees of flexion. One hand is placed on the patient's thigh and the other behind the tibia (with the thumb on the tibial tuberosity). The tibia is pulled anteriorly.
- The incidence of ACL tears has been found to be 20% when there is no valgus laxity on clinical examination, 53% with valgus laxity in 30 degrees of flexion, and 78% with valgus laxity in full knee extension.[5]

positive pivot shift test (uncommon)

- Used in conjunction with the Lachman's test for diagnosing anterior cruciate ligament (ACL) injury.
- An internal rotation and valgus stress is applied to the knee while taking it from 20 to 40 degrees of flexion. In an ACL-deficient knee, the tibia will anterolaterally sublux in the initial phase of flexion and then reduce with further flexion.

joint line tenderness (uncommon)

- Although not the most sensitive or specific sign for meniscal injury,[26] joint line tenderness may indicate potential meniscus pathology.

chronic pain (uncommon)

- Knowing when the patient injured his or her knee helps to distinguish acute from chronic MCL injury. A chronic MCL injury is one that has occurred ≥3 months previously.[4]

Risk factors

Strong

participation in activities involving valgus stress at the knee joint

- Valgus loads - occurring through contact, non-contact, or over-use mechanisms - are required for straining the MCL. Typically, a valgus load can be in the form of a lateral blow to the lower thigh or external rotation of the tibia relative to the femur. People who frequently experience these stresses on the knee (e.g., participants in American football, rugby, hockey, skiing) are most at risk.[5] [16] [17] [18]

age 20 to 35 years

- The highest incidence of MCL injury is in young adults, as this age group is most likely to engage in high-risk athletic pursuits.[15] [18]

age 55 to 70 years

- Older, less-active adults are prone to MCL injury during falls.[18]

Weak

weak muscles that cross the medial aspect of knee

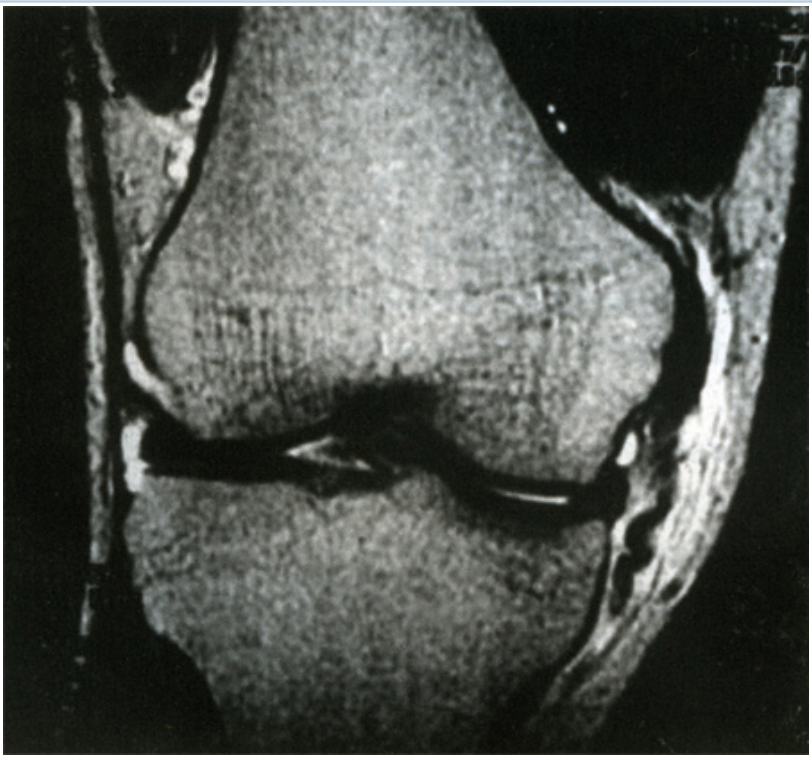
- Having weak muscles in the posterior aspect of the knee - pes anserinus mainly, but also the semimembranosus - may decrease the dynamic stability of the knee joint.[18] There is no firm evidence that this increases the likelihood of MCL injury.

Investigations

1st test to order

Test	Result
plain x-rays of knee • Ordered in accordance with the Ottawa knee rules to exclude bony injury. **Knee x-ray indications: Ottawa knee rules (acute)** • Age ≥55 years • Isolated patella tenderness • Tenderness at head of fibula • Inability to flex knee 90° • Inability to bear weight (4 steps) immediately after injury and in emergency department *X-ray indications in acute knee injury: the Ottawa knee rules* *Table created by Sanjeev Bhatia, MD. Adapted from Stiell IG, et al. Implementation of the Ottawa knee rule for the use of radiography in acute knee injuries. JAMA. 1997;278:2075-2079* [27] Anteroposterior, lateral, and patellofemoral views are often sufficient. • Pellegrini-Stieda lesions (a calcification that develops adjacent to the adductor tubercle) suggest a collateral ligament injury that is more than 6 weeks old. They are best seen in the anteroposterior view.	**may show associated fracture of the tibial plateau, patella, or distal femur; calcification adjacent to the adductor tubercle is typical of a Pellegrini-Stieda lesion in chronic situations**
stress x-rays of knee • Stress radiography x-rays taken with a valgus load on the knee at 20 degrees of flexion should be ordered in adolescents to rule out physeal injuries and also in adults to objectively define the amount of medial compartment gapping.	**greater than normal opening on the medial side of the knee joint is commonly seen; physeal fractures may be seen in adolescents; in adults, a greater than 3.2 mm side-to-side difference of medial gapping is suggestive of a grade III MCL injury**

Other tests to consider

Test	Result
MRI of knee • Provides excellent visualisation of soft tissue anatomy and is indicated if any associated injuries are suspected.[27] • MRI is also useful for identifying the precise location of the MCL tear, which is usually visible on T2-weighted images.  *T2-weighted MRI showing a medial collateral ligament injury* *From the collection of Sanjeev Bhatia, MD; used with permission*	**with an MCL tear, high signal oedema and haemorrhage may be seen in the low-signal ligament; may also show meniscal tear, anterior cruciate ligament or posterior cruciate ligament tear, bone bruise, osteochondral fracture**

Emerging tests

Test	Result
diagnostic ultrasound • Ultrasound is an excellent and efficient means for visualising the knee.[27] MCL tears, as well as associated injuries, may be visualised with a knee ultrasound. However, grade III MCL injuries (complete tears) are difficult to diagnose with ultrasound because of the irregular nature of ligament tearing.[24]	**MCL appears thickened and hypo-echoic (from oedema); fluid collection may be greatest near the site of the tear; Pellegrini-Stieda lesions appear as calcifications within thickened and hypoechoic ligament tissue.**

Differentials

Condition	Differentiating signs / symptoms	Differentiating tests
Medial meniscus tear	• Patients frequently complain of mechanical symptoms in their knees such as catching, giving way, locking, clicking, and popping; these symptoms are unusual in isolated MCL injuries. • May present with quadriceps atrophy and often have an associated knee effusion and tenderness localised to the joint line. In contrast, MCL injuries have tenderness above and below the joint line following the path of the MCL. The McMurray test can be used for diagnosing meniscal injury. It is performed with the patient lying supine and the examiner placing one hand on the lateral joint line, providing a valgus stress. If pain or a click is felt as the knee is externally rotated and brought into full extension, the examination is positive and suggestive of a medial meniscal tear. The McMurray test has a low positive predictive value (82.6%) and therefore has a limited role in clinical practice.[28]	• MRI is the most accurate test. MRI reports score the quality of the meniscus signal on a 0-III scale: grade 0 represents normal, healthy meniscus and grade III represents a torn meniscus. • Diagnostic ultrasound of the knee may also be useful in visualising pathology.
Soft tissue contusion of the medial knee	• Patients usually describe an object impacting the knee. • Absence of valgus laxity on abduction stress testing.	• MRI or ultrasound will show oedema surrounding the contusion but should demonstrate an intact MCL with normal-appearing fibres.
Tibial plateau fracture	• Usually involves a large force on the knee, commonly seen in major falls or motor vehicle accidents. • Significant pain, effusion, and joint stiffness are typical symptoms.	• Plain x-rays in multiple orientations (anteroposterior, lateral, patellofemoral, and oblique) will usually reveal a disruption of the tibial articular surface. • CT provides a more detailed view of the pathology.
Osteochondral fracture	• Immediate pain and swelling of the knee at the time of	• Osteochondral fractures may be missed on x-rays. CT

Condition	Differentiating signs / symptoms	Differentiating tests
	injury. Significant pain with weight-bearing. • Mechanism of injury usually involves a high-force, twisting injury of the knee.	and MRI are preferred as they provide more detailed images.
Pes anserinus bursitis	• Tenderness along the medial knee, exacerbated by ascending and descending stairs. Pain is usually absent when walking on a level surface. • Unlike MCL sprains, there is usually no history of acute injury. • Tenderness at the conjoint tendons of the pes anserinus, located 3 to 5 cm below the anteromedial margin of the knee. • No valgus laxity on abduction stress testing.	• T2-weighted MRI images demonstrate an increase in signal intensity in the pes anserinus bursa.

Criteria

American Medical Association Committee on the Medical Aspects of Sports standard nomenclature of athletic injuries[2]

MCL injuries are classified based on the amount of medial joint opening when a valgus load is applied at 20 to 30 degrees of knee flexion:

The abduction (valgus) stress test
From the collection of Sanjeev Bhatia, MD; used with permission

- Grade I: 0 to 5 mm of opening
- Grade II: 5 to 10 mm of opening
- Grade III: >10 mm of opening.

O'Donoghue's classification[1]

MCL injuries are classified based on the amount of torn fibres:

- Grade I: few torn fibres, ligament is structurally intact
- Grade II: incomplete tear, no pathological laxity
- Grade III: complete tear, pathological laxity.

Approach

Most MCL injuries are treated conservatively. Rest, ice, compression, and elevation (RICE), protective ambulation (ambulation with crutches or other assistive device), and physiotherapy are commonly employed treatment measures.

For treatment purposes, the American Medical Association classification of MCL injuries is used. MCL injuries are classified based on the amount of medial joint opening when a valgus load is applied at 20 to 30 degrees of knee flexion:[2]

- Grade I: 0 to 5 mm of opening
- Grade II: 5 to 10 mm of opening
- Grade III: >10 mm of opening

Acute treatment

Initially, all suspected knee sprains should be treated with the RICE protocol: rest, ice, compression of the knee with an elastic bandage, and elevation of the leg. Non-steroidal anti-inflammatory drugs can be given to further reduce swelling and provide pain relief. If the injured knee is unstable or exceptionally painful, a hinged knee brace or an immobilising knee brace and/or crutches should be used. Grade I injuries do not usually require protective ambulation but grade II and III injuries usually do. Grade III MCL injuries should be immobilised with a hinged knee brace set at 30 degrees flexion to minimise the distance between the two ends of the torn ligament.[29] A hinged brace that allows full flexion but minimises full extension is recommended for minimising strain on the MCL and protecting against further injury. It is critical that the brace has sufficient rigidity to stabilise medial and lateral movement. The brace should be worn for 4 to 6 weeks.

Hinged knee brace

From the collection of Sanjeev Bhatia, MD; used with permission

Physiotherapy

After swelling subsides and the patient can ambulate more easily, the patient should undertake a physiotherapy regimen aimed at improving quadriceps and hamstring strength. Most MCL injuries, even grade III, heal well non-operatively. Physiotherapy restores range of movement and improves muscle strength, resulting in decreased pain and increased knee function. Therapy begins with low-impact exercises, gradually progressing to more sport/activity-specific exercises. When sport-specific exercises, particularly those involving cutting and pivoting, can be performed without discomfort, patients are allowed to return to competitive play. Postoperative physiotherapy is an important part of the rehabilitation process, which all patients should receive.

Surgery

MCL injuries rarely require surgical reconstruction. The exceptions are chronic MCL injuries (≥3 months' duration with high-grade laxity) that have failed non-operative treatment[18] [30] [31] [4] and certain multiple-ligament knee injuries. Additionally, tibial-sided grade III MCL injuries are more prone to persistent laxity even after conservative management. These patients frequently have valgus instability even with activities of daily living.[30]

Surgery for isolated grade III MCL injury is sometimes indicated.[32] Acute grade III MCL injuries may warrant operative intervention if there is also a large bony avulsion, tibial plateau fracture, intra-articular entrapment of the end of a ligament, or anteromedial instability (positive anterior drawer test).

The anterior drawer test

From the collection of Sanjeev Bhatia, MD; used with permission

If undertaken, surgical repair is usually carried out 7 to 10 days after injury.[17] [18] [31] In many cases some mild degree of persistent instability remains even after successful reconstruction. Specific complications are unusual but include decreased range of motion (ROM) (if the MCL graft is placed in a non-anatomical position) and saphenous nerve injury.

In multi-ligament knee injuries, MCL reconstruction is usually warranted, as the healing process may be compromised due to the functional loss of other ligaments[33] and so predisposing to chronic MCL insufficiency.[30]

In combined MCL and anterior cruciate ligament (ACL) injuries, ACL reconstruction is generally recommended after a period of rehabilitation to allow the MCL to heal.[34] Surgery is performed after

achieving full ROM, adequate strength, and resolution of knee effusion.[7] [18] [35] This usually occurs 4 to 6 weeks after injury, when the ACL can then be reconstructed with a patellar tendon graft or hamstring tendon graft. An autograft or allograft tendon can be used with excellent results.

If valgus instability persists after ACL reconstruction, the patient should undergo surgical MCL reconstruction.[36] [37] MCL reconstruction may also be warranted if there is a large bony avulsion, tibial plateau fracture, intra-articular entrapment of the end of a ligament, or anteromedial instability (positive anterior drawer test).

In combined MCL and non-anterior ligament injuries, MCL repair is usually performed 7 to 10 days after injury. Surgical reconstruction or repair of the other injured ligament (posterior cruciate ligament, meniscus, lateral collateral ligament) is usually warranted within 3 weeks of injury. Compared with non-surgical management or a delay in surgery, early operative treatment of the multi-ligament-injured knee yields improved functional and clinical outcomes.[38] [39] In one meta-analysis, a staged approach to reconstruction yielded the best outcomes with regard to subjective scores and range of motion.[32] Reconstruction of the posterolateral corner is preferred over repair as it results in decreased revision rates.[38]

Both chronic MCL injuries and multiple knee ligament injuries should be referred to an orthopaedic specialist. Isolated grade III MCL injuries in high-demand athletes and labourers should also be referred for consultation.

Treatment algorithm overview

Please note that formulations/routes and doses may differ between drug names and brands, drug formularies, or locations. Treatment recommendations are specific to patient groups: see disclaimer

Acute (summary)		
isolated grade I injury		
	1st	rest, ice, compression, elevation (RICE) + physiotherapy
	adjunct	protective ambulation
	adjunct	non-steroidal anti-inflammatory drugs (NSAIDs)
isolated grade II injury		
	1st	rest, ice, compression, elevation (RICE) + physiotherapy + protective ambulation
	adjunct	non-steroidal anti-inflammatory drugs (NSAIDs)
isolated grade III injury		
	1st	rest, ice, compression, elevation (RICE) + physiotherapy + protective ambulation
	adjunct	non-steroidal anti-inflammatory drugs (NSAIDs)
	2nd	MCL reconstruction or repair
MCL + anterior cruciate ligament (ACL) combined injury		
	1st	rest, ice, compression, elevation (RICE) + physiotherapy + protective ambulation
	adjunct	non-steroidal anti-inflammatory drugs (NSAIDs)
	plus	ACL reconstruction or repair
	adjunct	MCL reconstruction or repair
MCL + non-anterior cruciate ligament (ACL) combined injury		
	1st	rest, ice, compression, elevation (RICE) + physiotherapy + protective ambulation
	adjunct	non-steroidal anti-inflammatory drugs (NSAIDs)
	plus	surgical repair of MCL + non-ACL ligament

Ongoing		(summary)
persistent high-grade valgus laxity after ≥3 months		
	1st	**ligament reconstruction or repair**
	plus	**physiotherapy**
	adjunct	**non-steroidal anti-inflammatory drugs (NSAIDs)**

Treatment algorithm

Please note that formulations/routes and doses may differ between drug names and brands, drug formularies, or locations. Treatment recommendations are specific to patient groups: see disclaimer

Acute

isolated grade I injury

1st **rest, ice, compression, elevation (RICE) + physiotherapy**

Primary options

» rest: rest the injured leg for 24-48 hours
Weight-bearing as tolerated ambulation.

-and-
» ice: apply ice or a cold pack for 20 minutes at a time, 4-8 times a day
Ice should not be left on for more than 20 consecutive minutes; otherwise, the skin could be damaged.

-and-
» compression: compress the knee with an elastic bandage or comparable device
-and-
» elevation: elevate the knee above the level of the heart; pillows are often helpful
-and-
» physiotherapy

» After an MCL injury, the damaged ligament will bleed internally and become inflamed. RICE is started immediately after injury to reduce pain, minimise swelling, and protect the injured tissue; all of which help to speed the healing process. RICE should be employed for 24 to 48 hours.

» The RICE protocol involves resting the injured leg, applying ice, compressing the knee with an elastic bandage, and elevating the leg above the level of the heart.

» Initially, the goal of physiotherapy is to decrease pain and restore range of motion (ROM). Once sufficient progress is made, the focus switches to rebuilding strength and regaining function. Therapy for 2 to 3 weeks is recommended.

» Exercises are frequently sport- or activity-specific and usually involve hydrotherapy, weight training, and agility training.

» Only after demonstrating pain-free ROM, 80% to 90% strength, and no swelling/effusion in

Acute

the lower extremity can the athlete return to sports.[18] [40]

adjunct **protective ambulation**

Treatment recommended for SOME patients in selected patient group

» Protective ambulation may not be needed with an isolated grade I injury; however, if the knee appears unstable or the injury is particularly painful, then it is recommended. A hinged knee brace that allows full flexion but minimises full extension is recommended for minimising strain on the MCL and protecting against further injury.

» It is critical that the brace has enough rigidity to stabilise medial and lateral movement. The brace should be worn for 4 to 6 weeks.

» Crutches may be used for further comfort.

adjunct **non-steroidal anti-inflammatory drugs (NSAIDs)**

Treatment recommended for SOME patients in selected patient group

Primary options

» ibuprofen: 400-800 mg orally every 6-8 hours when required, maximum 2400 mg/day

OR

» naproxen: 500 mg orally every 12 hours when required, maximum 1250 mg/day

» NSAIDs inhibit cyclo-oxygenase activity and curb prostaglandin synthesis. Their analgesic and anti-inflammatory properties may improve pain and reduce swelling.

» Caution should be used when prescribing NSAIDs because they may have adverse effects or cause drug interactions in certain groups. They are contraindicated in patients with peptic ulcer disease, recent gastrointestinal bleeding/ perforation, or renal disease.

isolated grade II injury

1st **rest, ice, compression, elevation (RICE) + physiotherapy + protective ambulation**

Primary options

» rest: rest the injured leg for 24-48 hours Weight-bearing as tolerated ambulation.

-and-

MANAGEMENT

Acute

» ice: apply ice or a cold pack for 20 minutes at a time, 4-8 times a day
Ice should not be left on for more than 20 consecutive minutes; otherwise, the skin could be damaged.

-and-
» compression: compress the knee with an elastic bandage or comparable device
-and-
» elevation: elevate the knee above the level of the heart; pillows are often helpful
-and-
» physiotherapy
-and-
» protective ambulation

» After an MCL injury, the damaged ligament will bleed internally and become inflamed. RICE is started immediately after injury to reduce pain, minimise swelling, and protect the injured tissue; all of which help to speed the healing process. RICE should be employed for 24 to 48 hours.

» The RICE protocol involves resting the injured leg, applying ice, compressing the knee with an elastic bandage, and elevating the leg above the level of the heart.

» Initially, the goal of physiotherapy is to decrease pain and restore range of motion (ROM). Once sufficient progress is made, the focus switches to rebuilding strength and regaining function.

» Therapy for 3 to 4 weeks is recommended.

» Exercises are frequently sport- or activity-specific and usually involve hydrotherapy, weight training, and agility training.

» Only after demonstrating pain-free ROM, 80% to 90% strength, and no swelling/effusion in the lower extremity can the athlete return to sports.[18] [40]

» A hinged brace that allows full flexion but minimises full extension is recommended for minimising strain on the MCL and protecting against further injury.

» It is critical that the brace has enough rigidity to stabilise medial and lateral movement. The brace should be worn for 4 to 6 weeks.

» Crutches may be used for further comfort.

Acute

adjunct **non-steroidal anti-inflammatory drugs (NSAIDs)**

Treatment recommended for SOME patients in selected patient group

Primary options

» ibuprofen: 400-800 mg orally every 6-8 hours when required, maximum 2400 mg/day

OR

» naproxen: 500 mg orally every 12 hours when required, maximum 1250 mg/day

» NSAIDs inhibit cyclo-oxygenase activity and curb prostaglandin synthesis. Their analgesic and anti-inflammatory properties may improve pain and reduce swelling.

» Caution should be used when prescribing NSAIDs because they may have adverse effects or cause drug interactions in certain groups. They are contraindicated in patients with peptic ulcer disease, recent gastrointestinal bleeding/perforation, or renal disease.

isolated grade III injury

1st **rest, ice, compression, elevation (RICE) + physiotherapy + protective ambulation**

Primary options

» rest: rest the injured leg for 24-48 hours
Avoid bearing weight on affected leg.

-and-
» ice: apply ice or a cold pack for 20 minutes at a time, 4-8 times a day
Ice should not be left on for more than 20 consecutive minutes; otherwise, the skin could be damaged.

-and-
» compression: compress the knee with an elastic bandage or comparable device
-and-
» elevation: elevate the knee above the level of the heart; pillows are often helpful
-and-
» physiotherapy
-and-
» protective ambulation

» After an MCL injury, the damaged ligament will bleed internally and become inflamed. RICE is

MANAGEMENT

Acute

started immediately after injury to reduce pain, minimise swelling, and protect the injured tissue, all of which help to speed the healing process. RICE should be employed for 24 to 48 hours.

» The RICE protocol involves resting the injured leg, applying ice, compressing the knee with an elastic bandage, and elevating the leg above the level of the heart.

» Initially, the goal of physiotherapy is to decrease pain and restore range of motion (ROM). Once sufficient progress is made, the focus switches to rebuilding strength and regaining function.

» Physiotherapy for 8 to 12 weeks is recommended.

» Exercises are frequently sport- or acitivty-specific and usually involve hydrotherapy, weight training, and agility training.

» Only after demonstrating pain-free ROM, 80% to 90% strength, and no swelling/effusion in the lower extremity can the athlete return to sports.[18] [40]

» A hinged brace that allows full flexion but minimises full extension is recommended for minimising strain on the MCL and protecting against further injury. Grade III MCL injuries should be immobilised using a hinged knee brace with the knee at 30 degrees flexion to minimise the distance between the two ends of the torn ligament.

» It is critical that the hinged knee brace has enough rigidity to stabilise medial and lateral movement. Patient can gradually progress to full weight-bearing over 4 weeks. The brace should be worn for 4 to 6 weeks.

» Crutches may be used for further comfort.

adjunct **non-steroidal anti-inflammatory drugs (NSAIDs)**

Treatment recommended for SOME patients in selected patient group

Primary options

» ibuprofen: 400-800 mg orally every 6-8 hours when required, maximum 2400 mg/day

OR

Acute

» naproxen: 500 mg orally every 12 hours when required, maximum 1250 mg/day

» NSAIDs inhibit cyclo-oxygenase activity and curb prostaglandin synthesis. Their analgesic and anti-inflammatory properties may improve pain and reduce swelling.

» Caution should be used when prescribing NSAIDs because they may have adverse effects or cause drug interactions in certain groups. They are contraindicated in patients with peptic ulcer disease, recent gastrointestinal bleeding/perforation, or renal disease.

2nd **MCL reconstruction or repair**

» Surgical intervention for acute grade III MCL injuries is still controversial. Isolated grade III MCL injuries may warrant operative intervention if there is also a large bony avulsion, tibial plateau fracture, intra-articular entrapment of the end of a ligament, or anteromedial instability (positive anterior drawer test).

The anterior drawer test
From the collection of Sanjeev Bhatia, MD; used with permission

» MCL repair is usually performed 7 to 10 days after injury.[17] [18] [31]

» In many cases some mild degree of persistent instability remains even after successful reconstruction. Specific complications are unusual, but include decreased range of motion (if the MCL graft is placed in a non-anatomical position) and saphenous nerve injury.

MCL + anterior cruciate ligament (ACL) combined injury

1st **rest, ice, compression, elevation (RICE) + physiotherapy + protective ambulation**

MANAGEMENT

Acute

Primary options

» rest: rest the injured leg for 24-48 hours
Avoid bearing weight on affected leg.

-and-
» ice: apply ice or a cold pack for 20 minutes at a time, 4-8 times a day
Ice should not be left on for more than 20 consecutive minutes; otherwise, the skin could be damaged.

-and-
» compression: compress the knee with an elastic bandage or comparable device
-and-
» elevation: elevate the knee above the level of the heart; pillows are often helpful
-and-
» physiotherapy
-and-
» protective ambulation

» After an MCL/anterior cruciate ligament (ACL) injury, the damaged ligaments will bleed internally and become inflamed. RICE is started immediately after injury to reduce pain, minimise swelling, and protect the injured tissue, all of which help to speed the healing process. RICE should be employed for 24 to 48 hours.

» The RICE protocol involves resting the injured leg, applying ice, compressing the knee with an elastic bandage, and elevating the leg above the level of the heart.

» Prior to surgery, MCL/ACL injury rehabilitation should focus on regaining range of motion (ROM), rebuilding strength, and resolving knee effusion. This typically takes 4 to 6 weeks.

» Postoperative rehabilitation generally requires a rigorous physiotherapy regimen.

» A brace locked in full extension should be used during weight-bearing to minimise strain on the MCL and protect against additional injury.

» The brace should be opened for ROM exercises. It should be worn for 4 to 6 weeks.

» Crutches may be used for further comfort.

adjunct **non-steroidal anti-inflammatory drugs (NSAIDs)**

Treatment recommended for SOME patients in selected patient group

Acute

Primary options

» ibuprofen: 400-800 mg orally every 6-8 hours when required, maximum 2400 mg/day

OR

» naproxen: 500 mg orally every 12 hours when required, maximum 1250 mg/day

» NSAIDs inhibit cyclo-oxygenase activity and curb prostaglandin synthesis. Their analgesic and anti-inflammatory properties may improve pain and reduce swelling.

» Caution should be used when prescribing NSAIDs because they may have adverse effects or cause drug interactions in certain groups.

» They are contraindicated in patients with peptic ulcer disease, recent gastrointestinal bleeding/perforation, or renal disease.

plus **ACL reconstruction or repair**

Treatment recommended for ALL patients in selected patient group

» Anterior cruciate ligament (ACL) reconstruction is generally recommended after a period of rehabilitation to allow the MCL to heal. Surgery is performed after achieving full range of motion and adequate strength, and resolution of knee effusion.[7] [18] [35] At approximately 4 to 6 weeks after injury, the ACL can be reconstructed with a patellar tendon graft or hamstring tendon graft. An autograft or allograft tendon can be used with excellent results.

adjunct **MCL reconstruction or repair**

Treatment recommended for SOME patients in selected patient group

» If valgus instability persists after anterior cruciate ligament reconstruction, the patient should undergo surgical MCL reconstruction. MCL reconstruction may also be warranted if there is a large bony avulsion, tibial plateau fracture, intra-articular entrapment of the end of a ligament, or anteromedial instability (positive anterior drawer test).

Acute

The anterior drawer test
From the collection of Sanjeev Bhatia, MD; used with permission

» In many cases some mild degree of persistent instability remains even after successful reconstruction. Specific complications are unusual, but include decreased range of motion (if the MCL graft is placed in a non-anatomical position) and saphenous nerve injury.

MCL + non-anterior cruciate ligament (ACL) combined injury

1st **rest, ice, compression, elevation (RICE) + physiotherapy + protective ambulation**

Primary options

» rest: rest the injured leg for 24-48 hours
Avoid bearing weight on affected leg.

-and-
» ice: apply ice or a cold pack for 20 minutes at a time, 4-8 times a day
Ice should not be left on for more than 20 consecutive minutes; otherwise, the skin could be damaged.

-and-
» compression: compress the knee with an elastic bandage or comparable device
-and-
» elevation: elevate the knee above the level of the heart; pillows are often helpful
-and-
» physiotherapy
-and-
» protective ambulation

» After a multi-ligament injury, the damaged ligaments will bleed internally and become inflamed. RICE is started immediately after injury

Acute

to reduce pain, minimise swelling, and protect the injured tissue, all of which help to speed the healing process. RICE should be employed for 24 to 48 hours.

» The RICE protocol involves resting the injured leg, applying ice, compressing the knee with an elastic bandage, and elevating the leg above the level of the heart.

» Prior to surgery, multi-ligament injury rehabilitation should focus on regaining range of motion (ROM) and resolving knee effusion. This typically takes 2 to 3 weeks. Postoperative rehabilitation generally requires a rigorous physiotherapy regimen.

» A brace locked in full extension should be used during weight-bearing to minimise strain on the MCL and protect against additional injury. The brace should be opened for ROM exercises. It should be worn for 4 to 6 weeks.

» Crutches may be used for further comfort.

adjunct **non-steroidal anti-inflammatory drugs (NSAIDs)**

Treatment recommended for SOME patients in selected patient group

Primary options

» ibuprofen: 400-800 mg orally every 6-8 hours when required, maximum 2400 mg/day

OR

» naproxen: 500 mg orally every 12 hours when required, maximum 1250 mg/day

» NSAIDs inhibit cyclo-oxygenase activity and curb prostaglandin synthesis. Their analgesic and anti-inflammatory properties may improve pain and reduce swelling.

» Caution should be used when prescribing NSAIDs because they may have adverse effects or cause drug interactions in certain groups.

» They are contraindicated in patients with peptic ulcer disease, recent gastrointestinal bleeding/perforation, or renal disease.

plus **surgical repair of MCL + non-ACL ligament**

Treatment recommended for ALL patients in selected patient group

» MCL reconstruction is usually warranted because its healing capacity may be

Acute

compromised in multi-ligament injuries.[33] Surgery is especially warranted if there is a large bony avulsion, tibial plateau fracture, intra-articular entrapment of the end of a ligament, or anteromedial instability (positive anterior drawer test).

The anterior drawer test
From the collection of Sanjeev Bhatia, MD; used with permission

» MCL repair is usually performed 7 to 10 days after injury.

» In many cases some mild degree of persistent instability remains even after successful reconstruction. Specific complications are unusual, but include decreased range of motion (if the MCL graft is placed in a non-anatomical position) and saphenous nerve injury.

» Surgical reconstruction or repair of the other injured ligament (posterior cruciate ligament, meniscus, lateral collateral ligament) is usually warranted shortly (<3 weeks) after injury. Compared with non-surgical management or a delay in surgery, early operative treatment of the multi-ligament-injured knee yields improved functional and clinical outcomes.[38] [39] Reconstruction of the posterolateral corner is preferred over repair as it results in decreased revision rates.[38]

Ongoing

persistent high-grade valgus laxity after ≥3 months

1st **ligament reconstruction or repair**

» Chronic valgus instability, defined as persistent high-grade valgus laxity after 3 or more months, usually requires surgical reconstruction of the superficial MCL.[18] [30] [31] Quadriceps tendon autograft, hamstring autograft, hamstring allograft, and Achilles allograft are frequently used.

plus **physiotherapy**

Treatment recommended for ALL patients in selected patient group

» Since chronic MCL injuries are generally treated surgically, physiotherapy will be a necessary and crucial step for postoperative rehabilitation. The exact regimen depends on the type of reconstructive surgery.

adjunct **non-steroidal anti-inflammatory drugs (NSAIDs)**

Treatment recommended for SOME patients in selected patient group

Primary options

» ibuprofen: 400-800 mg orally every 6-8 hours when required, maximum 2400 mg/day

OR

» naproxen: 500 mg orally every 12 hours when required, maximum 1250 mg/day

» NSAIDs inhibit cyclo-oxygenase activity and curb prostaglandin synthesis. Their analgesic and anti-inflammatory properties may improve pain and reduce swelling.

» Caution should be used when prescribing NSAIDs because they may have adverse effects or cause drug interactions in certain groups.

» They are contraindicated in patients with peptic ulcer disease, recent gastrointestinal bleeding/perforation, or renal disease.

Emerging

Improved surgical techniques

Improved surgical techniques are emerging for MCL reconstruction. One such technique is use of an Achilles allograft for MCL reconstruction. With the continued advancement of imaging modalities, grading of injuries, and low-impact surgical techniques, surgical intervention for MCL injuries may have a more prominent role.[18]

Primary prevention

The best primary prevention for MCL injury is to decrease exposure to valgus stresses at the knee. Potential means for achieving this include minimising participation in high-risk activities (e.g., skiing and contact sports), using proper technique and equipment when participating in such activities, and wearing a stabilising knee brace.

Secondary prevention

There are no specific secondary prevention measures for MCL injuries. However, regular exercise of leg muscles to strengthen musculature surrounding the knee can promote general knee stability.

Patient discussions

Patients may require training on how to use appropriate assistive devices (e.g., knee brace or crutches). Education is an integral component of the patient's recovery process. This includes knowing how to properly use the rest, ice, compression, and elevation (RICE) protocol and other treatment modalities, as well as having a home exercise programme to increase knee joint stability.

FOLLOW UP

Monitoring

Monitoring

It is not necessary to monitor medial knee function on a long-term basis unless the patient is symptomatic. Nonetheless, patients can be seen periodically every few weeks after initial injury to monitor progress and ensure compliance with treatment measures.

Complications

Complications	Timeframe	Likelihood
Pellegrini-Stieda's lesion	**long term**	**low**
A calcification that develops adjacent to the adductor tubercle. This complication results from a non-healing collateral ligament injury (usually >6 weeks old). Pellegrini-Stieda's disease will be visible on anteroposterior x-rays.		
osteoarthritis	**long term**	**low**
The incidence of knee osteoarthritis after isolated MCL injuries is quite low. There is a higher incidence after multi-ligament injuries and chronic MCL injury.[41] [42]		
knee joint stiffness	**variable**	**medium**
The likelihood of developing stiffness in the knee joint after acute injury is much higher if no physiotherapy is employed. Range of motion exercises dramatically reduce the incidence.		
chronic MCL insufficiency	**variable**	**low**
Persistent valgus instability can occur after acute MCL injury if the ligament has not adequately healed. The incidence of chronic MCL injury is higher after multi-ligament injuries and MCL/anterior cruciate ligament combined injuries. Chronic MCL injuries usually need operative repair. Referral to an orthopaedic specialist is recommended.		

Prognosis

Isolated MCL injuries

The prognosis for return to pre-injury level is excellent. The time for returning to sports depends on the grade of injury:

- Grade I: 2 to 3 weeks
- Grade II: 3 to 4 weeks
- Grade III: 6 to 12 weeks

Long-term outcome studies have demonstrated that isolated MCL injuries have a good prognosis for function and sporting performance.[41] Further, isolated partial MCL ruptures have been found to have only a 10% incidence of re-injury within 10 years.[42]

MCL/anterior cruciate ligament combined injury

MCL/anterior cruciate ligament combined injuries have a good prognosis for full recovery, although the rehabilitation process is much lengthier. There is a higher incidence of re-injury, increased knee laxity, and osteoarthritic changes in this patient group.[41] [42]

MCL/multi-ligament combined injury

These injuries have a fair prognosis for full recovery. There is a higher incidence of re-injury, increased knee laxity, and osteoarthritic changes in this patient group.[41] [42]

Chronic MCL injury

Postoperative prognosis depends on type of MCL repair and the length of time the patient had chronic valgus laxity. In most patients, full functional recovery can be expected in 6 to 12 months.[31]

Diagnostic guidelines

North America

The posteromedial corner of the knee: an international expert consensus statement on diagnosis, classification, treatment, and rehabilitation (https://www.springer.com/journal/167)

Published by: Knee Surgery, Sports Traumatology, Arthroscopy **Last published:** 2021

ACR appropriateness criteria: acute trauma to the knee (https://www.acr.org/Clinical-Resources/Clinical-Tools-and-Reference/Appropriateness-Criteria)

Published by: American College of Radiology **Last published:** 2019

Treatment guidelines

North America

Treatment of combined injuries to the ACL and the MCL complex: a consensus statement of the Ligament Injury Committee of the German Knee Society (DKG) (https://journals.sagepub.com/articles/OJS)

Published by: Orthopaedic Journal of Sports Medicine **Last published:** 2021

The posteromedial corner of the knee: an international expert consensus statement on diagnosis, classification, treatment, and rehabilitation (https://www.springer.com/journal/167)

Published by: Knee Surgery, Sports Traumatology, Arthroscopy **Last published:** 2021

ACR appropriateness criteria: acute trauma to the knee (https://www.acr.org/Clinical-Resources/Clinical-Tools-and-Reference/Appropriateness-Criteria)

Published by: American College of Radiology **Last published:** 2019

Online resources

1. Knee exam (9 of 27): inspection & palpation: supine (https://www.youtube.com/watch?v=ONA_y0znCoU) *(external link)*

2. Knee exam (14 of 27): MCL (https://www.youtube.com/watch?v=NMi2RsAohSw) *(external link)*

REFERENCES

Key articles

- O'Donoghue DH. An analysis of end results of surgical treatment of major injuries to the ligaments of the knee. J Bone Joint Surg. 1955 Jan;37-A(1):1-13. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/13233264?tool=bestpractice.bmj.com)
- American Medical Association, Committee on the Medical Aspects of Sports. Standard nomenclature of athletic injuries. Physical Therapy. 1969 Nov;49(11):1323. Full text (https://academic.oup.com/ptj/article-abstract/49/11/1323/4595828)
- Fetto JF, Marshall JL. Medial collateral ligament injuries of the knee: a rationale for treatment. Clin Orthop Relat Res. 1978 May;(132):206-18. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/679543?tool=bestpractice.bmj.com)
- Warren RF, Marshall JL. Injuries of the anterior cruciate and medial collateral ligaments of the knee. A long-term follow-up of 86 cases - part II. Clin Orthop Relat Res. 1978 Oct;(136):198-211. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/729286?tool=bestpractice.bmj.com)
- Phisitkul P, James SL, Wolf BR, et al. MCL injuries of the knee: current concepts review. Iowa Orthop J. 2006 Feb;26:77-90. Full text (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1888587) Abstract (http://www.ncbi.nlm.nih.gov/pubmed/16789454?tool=bestpractice.bmj.com)
- Wijdicks CA, Griffith CJ, Johansen S, et al. Injuries to the medial collateral ligament and associated medial structures of the knee. J Bone Joint Surg Am. 2010 May;92(5):1266-80. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/20439679?tool=bestpractice.bmj.com)
- Halinen J, Lindahl J, Hirvensalo E, et al. Operative and nonoperative treatments of medial collateral ligament rupture with early anterior cruciate ligament reconstruction: a prospective randomized study. Am J Sports Med. 2006 Jul;34(7):1134-40. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/16452264?tool=bestpractice.bmj.com)
- Marchant MH Jr, Tibor LM, Sekiya JK, et al. Management of medial-sided knee injuries, part 1: medial collateral ligament. Am J Sports Med. 2011 May;39(5):1102-13. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/21148144?tool=bestpractice.bmj.com)
- Giannotti BF, Rudy T, Graziano J. The non-surgical management of isolated medial collateral injuries of the knee. Sports Med Arthrosc. 2006 Jun;14(2):74-7. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/17135950?tool=bestpractice.bmj.com)

References

1. O'Donoghue DH. An analysis of end results of surgical treatment of major injuries to the ligaments of the knee. J Bone Joint Surg. 1955 Jan;37-A(1):1-13. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/13233264?tool=bestpractice.bmj.com)

2. American Medical Association, Committee on the Medical Aspects of Sports. Standard nomenclature of athletic injuries. Physical Therapy. 1969 Nov;49(11):1323. Full text (https://academic.oup.com/ptj/article-abstract/49/11/1323/4595828)

3. Makhmalbaf H, Shahpari O. Medial collateral ligament injury; a new classification based on MRI and clinical findings. A guide for patient selection and early surgical intervention. Arch Bone Jt Surg. 2018 Jan;6(1):3-7. Full text (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5799597) Abstract (http://www.ncbi.nlm.nih.gov/pubmed/29430488?tool=bestpractice.bmj.com)

4. Slocum DB, Larson RL, James SL. Late reconstruction procedures used to stabilize the knee. Orthop Clin North Am. 1973 Jul;4(3):679-89. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/4593504?tool=bestpractice.bmj.com)

5. Fetto JF, Marshall JL. Medial collateral ligament injuries of the knee: a rationale for treatment. Clin Orthop Relat Res. 1978 May;(132):206-18. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/679543?tool=bestpractice.bmj.com)

6. Hughston JC, Barrett GR. Acute anteromedial rotator instability. Long-term results of surgical repair. J Bone Joint Surg Am. 1983 Feb;65(2):145-53. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/6687390?tool=bestpractice.bmj.com)

7. Warren RF, Marshall JL. Injuries of the anterior cruciate and medial collateral ligaments of the knee. A long-term follow-up of 86 cases - part II. Clin Orthop Relat Res. 1978 Oct;(136):198-211. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/729286?tool=bestpractice.bmj.com)

8. Abbot LC, Saunders JB, Bost FC, et al. Injuries to ligaments of the knee joint. J Bone Joint Surg. 1944 Jul 1;26:503-21.

9. Andrews K, Lu A, Mckean L, et al. Review: Medial collateral ligament injuries. J Orthop. 2017 Aug 15;14(4):550-54. Full text (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5581380) Abstract (http://www.ncbi.nlm.nih.gov/pubmed/28878515?tool=bestpractice.bmj.com)

10. Meyers MC, Barnhill BS. Incidence, causes, and severity of high school football injuries on FieldTurf versus natural grass: a 5-year prospective study. Am J Sports Med. 2004 Oct-Nov;32(7):1626-38. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/15494326?tool=bestpractice.bmj.com)

11. Paletta GA, Warren RF. Knee injuries and alpine skiing. Treatment and rehabilitation. Sports Med. 1994 Jun;17(6):411-23. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/8091049?tool=bestpractice.bmj.com)

12. Dallalana RJ, Brooks JH, Kemp SP, et al. The epidemiology of knee injuries in English professional rugby union. Am J Sports Med. 2007 May;35(5):818-30. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/17293461?tool=bestpractice.bmj.com)

13. Gardiner JC, Weiss JA, Rosenberg TD. Strain in the human medial collateral ligament during valgus loading of the knee. Clin Orthop Relat Res. 2001 Oct;(391):266-74. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/11603680?tool=bestpractice.bmj.com)

REFERENCES

14. Weiss JA, Woo SL, Ohland KJ, et al. Evaluation of a new injury model to study medial collateral ligament healing: primary repair versus nonoperative treatment. J Orthop Res. 1991 Jul;9(4):516-28. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/2045978?tool=bestpractice.bmj.com)

15. Hughston JC, Andrews JR, Cross MJ, et al. Classification of knee ligament instabilities. Part I. The medial compartment and cruciate ligaments. J Bone Joint Surg Am. 1976 Mar;58(2):159-72. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/1254619?tool=bestpractice.bmj.com)

16. Edson CJ. Conservative and postoperative rehabilitation of isolated and combined injuries of the medial collateral ligament. Sports Med Arthrosc. 2006 Jun;14(2):105-10. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/17135955?tool=bestpractice.bmj.com)

17. Jacobson KE, Chi FS. Evaluation and treatment of medial collateral ligament and medial-sided injuries of the knee. Sports Med Arthrosc. 2006 Jun;14(2):58-66. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/17135948?tool=bestpractice.bmj.com)

18. Phisitkul P, James SL, Wolf BR, et al. MCL injuries of the knee: current concepts review. Iowa Orthop J. 2006 Feb;26:77-90. Full text (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1888587) Abstract (http://www.ncbi.nlm.nih.gov/pubmed/16789454?tool=bestpractice.bmj.com)

19. Indelicato P, Linton R. Medial ligament injuries in the adult. In: DeLee J, Drez, D, Miller MD, eds. DeLee & Drez's orthopaedic sports medicine. 2nd ed. Philadelphia, PA: WB Saunders; 2003:1938-19.

20. Garvin GJ, Munk PL, Vellet AD. Tears of the medial collateral ligament: magnetic resonance imaging findings and associated injuries. Can Assoc Radiol J. 1993 Jun;44(3):199-204. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/8504333?tool=bestpractice.bmj.com)

21. Sims WF, Jacobson KE. The posteromedial corner of the knee: medial-sided injury patterns revisited. Am J Sports Med. 2004 Mar;32(2):337-45. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/14977657?tool=bestpractice.bmj.com)

22. Donaldson WF 3rd, Warren RF, Wickiewicz T. A comparison of acute anterior cruciate ligament examinations. Initial versus examination under anesthesia. Am J Sports Med. 1985 Jan-Feb;13(1):5-10. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/3976980?tool=bestpractice.bmj.com)

23. Laprade RF, Bernhardson AS, Griffith CJ, et al. Correlation of valgus stress radiographs with medial knee ligament injuries: an in vitro biomechanical study. Am J Sports Med. 2010 Feb;38(2):330-8. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/19966093?tool=bestpractice.bmj.com)

24. Lee D, Bouffard JA. Ultrasound of the knee. Eur J Ultrasound. 2001 Oct;14(1):57-71. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/11567855?tool=bestpractice.bmj.com)

25. Meyer P, Reiter A, Akoto R, et al. Imaging of the medial collateral ligament of the knee: a systematic review. Arch Orthop Trauma Surg. 2022 Dec;142(12):3721-36. Full text (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9596543) Abstract (http://www.ncbi.nlm.nih.gov/pubmed/34628563?tool=bestpractice.bmj.com)

26. Shelbourne KD, Martini DJ, McCarroll JR, et al. Correlation of joint line tenderness and meniscal lesions in patients with acute anterior cruciate ligament tears. Am J Sports Med. 1995 Mar-Apr;23(2):166-9. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/7778700?tool=bestpractice.bmj.com)

27. Bussieres AE, Taylor JA, Peterson C. Diagnostic imaging practice guidelines for musculoskeletal complaints in adults - an evidence-based approach. Part 1. Lower extremity disorders. J Manipulative Physiol Ther. 2007 Nov-Dec;30(9):684-717. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/18082743?tool=bestpractice.bmj.com)

28. Corea JR, Moussa M, al Othman A. McMurray's test tested. Knee Surg Sports Traumatol Arthrosc. 1994;2(2):70-2. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/7584186?tool=bestpractice.bmj.com)

29. Logerstedt DS, Snyder-Mackler L, Ritter RC, et al. Knee stability and movement coordination impairments: knee ligament sprain. J Orthop Sports Phys Ther. 2010 Apr;40(4):A1-A37. Full text (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3158982) Abstract (http://www.ncbi.nlm.nih.gov/pubmed/20357420?tool=bestpractice.bmj.com)

30. Rue JPH, Lewis PB, Detterline AJ, et al. Minimally invasive medial collateral ligament reconstruction using Achilles tendon allograft. Tech Knee Surg. 2007;6:266-73.

31. Azar FM. Evaluation and treatment of chronic medial collateral ligament injuries of the knee. Sports Med Arthrosc. 2006 Jun;14(2):84-90. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/17135952?tool=bestpractice.bmj.com)

32. Mook WR, Miller MD, Diduch DR, et al. Multiple-ligament knee injuries: a systematic review of the timing of operative intervention and postoperative rehabilitation. J Bone Joint Surg Am. 2009 Dec;91(12):2946-57. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/19952260?tool=bestpractice.bmj.com)

33. Woo SL, Young EP, Ohland KJ, et al. The effects of transaction of the anterior cruciate ligament on healing of the medial collateral ligament: a biomechanical study of the knee in dogs. J Bone Joint Surg Am. 1990 Mar;72(3):382-92. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/2312534?tool=bestpractice.bmj.com)

34. Wijdicks CA, Griffith CJ, Johansen S, et al. Injuries to the medial collateral ligament and associated medial structures of the knee. J Bone Joint Surg Am. 2010 May;92(5):1266-80. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/20439679?tool=bestpractice.bmj.com)

35. Halinen J, Lindahl J, Hirvensalo E, et al. Operative and nonoperative treatments of medial collateral ligament rupture with early anterior cruciate ligament reconstruction: a prospective randomized study. Am J Sports Med. 2006 Jul;34(7):1134-40. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/16452264?tool=bestpractice.bmj.com)

36. Marchant MH Jr, Tibor LM, Sekiya JK, et al. Management of medial-sided knee injuries, part 1: medial collateral ligament. Am J Sports Med. 2011 May;39(5):1102-13. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/21148144?tool=bestpractice.bmj.com)

REFERENCES

37. Grant JA, Tannenbaum E, Miller BS, et al. Treatment of combined complete tears of the anterior cruciate and medial collateral ligaments. Arthroscopy. 2012 Jan;28(1):110-22. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/22119290?tool=bestpractice.bmj.com)

38. Levy BA, Dajani KA, Whelan DB, et al. Decision making in the multiligament-injured knee: an evidence-based systematic review. Arthroscopy. 2009 Apr;25(4):430-8. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/19341932?tool=bestpractice.bmj.com)

39. Peskun CJ, Whelan DB. Outcomes of operative and nonoperative treatment of multiligament knee injuries: an evidence-based review. Sports Med Arthrosc. 2011 Jun;19(2):167-73. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/21540715?tool=bestpractice.bmj.com)

40. Giannotti BF, Rudy T, Graziano J. The non-surgical management of isolated medial collateral injuries of the knee. Sports Med Arthrosc. 2006 Jun;14(2):74-7. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/17135950?tool=bestpractice.bmj.com)

41. Lundberg M, Messner K. Ten-year prognosis of isolated and combined medial collateral ligament ruptures: a matched comparison in 40 patients using clinical and radiographic evaluations. Am J Sports Med. 1997 Jan-Feb;25(1):2-6. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/9006684?tool=bestpractice.bmj.com)

42. Lundberg M, Messner K. Long-term prognosis of isolated partial medial collateral ligament ruptures: a ten-year clinical and radiographic evaluation of a prospectively observed group of patients. Am J Sports Med. 1996 Mar-Apr;24(2):160-3. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/8775113?tool=bestpractice.bmj.com)

Images

Figure 1: Medial collateral ligament (right knee)

Created by Sanjeev Bhatia, MD; used with permission

Figure 2: The abduction (valgus) stress test

From the collection of Sanjeev Bhatia, MD; used with permission

Figure 3: The anterior drawer test

From the collection of Sanjeev Bhatia, MD; used with permission

Figure 4: The Lachman's test

From the collection of Sanjeev Bhatia, MD; used with permission

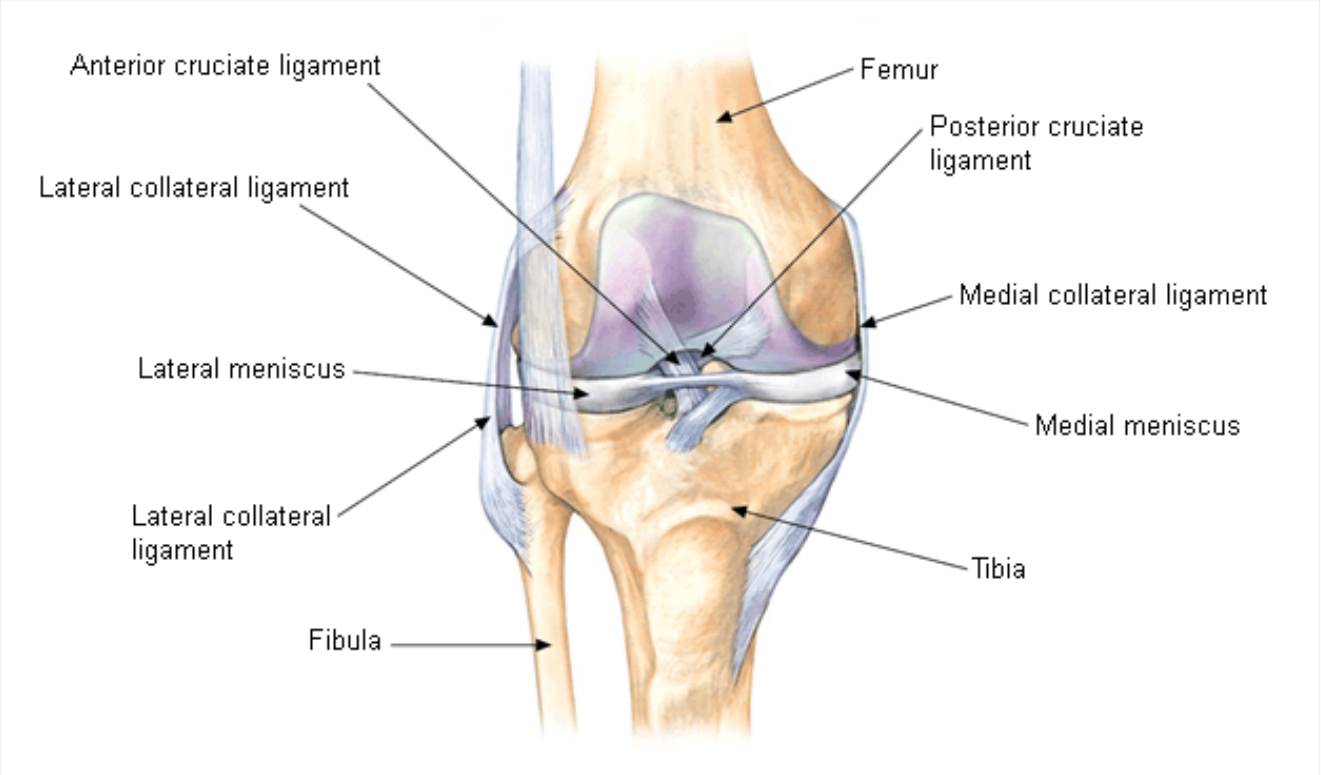


Figure 5: Anterior knee anatomy (right knee), patella removed

Created by Sanjeev Bhatia, MD; used with permission

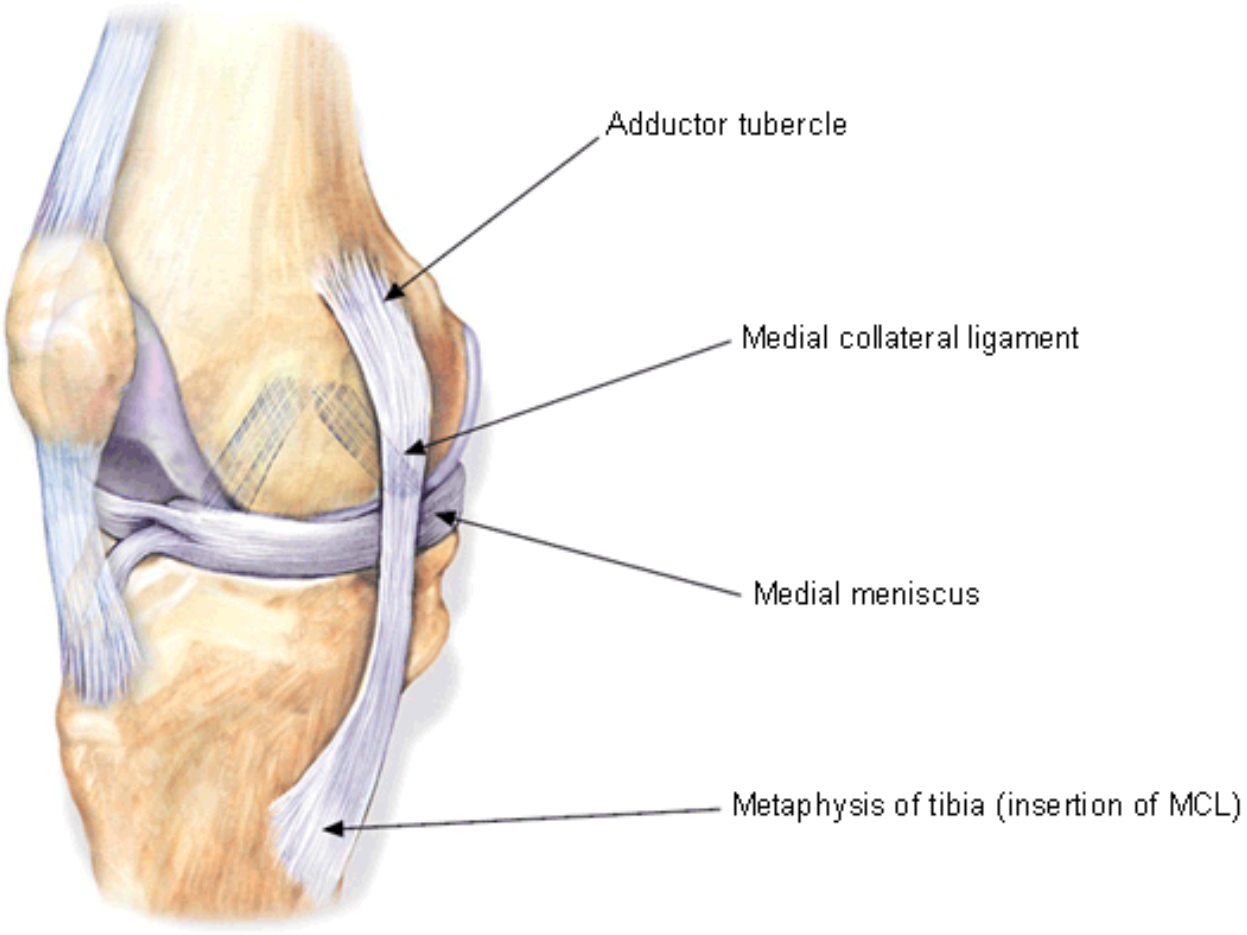


Figure 6: Oblique view of medial knee (right knee). MCL: medial collateral ligament

Created by Sanjeev Bhatia, MD; used with permission

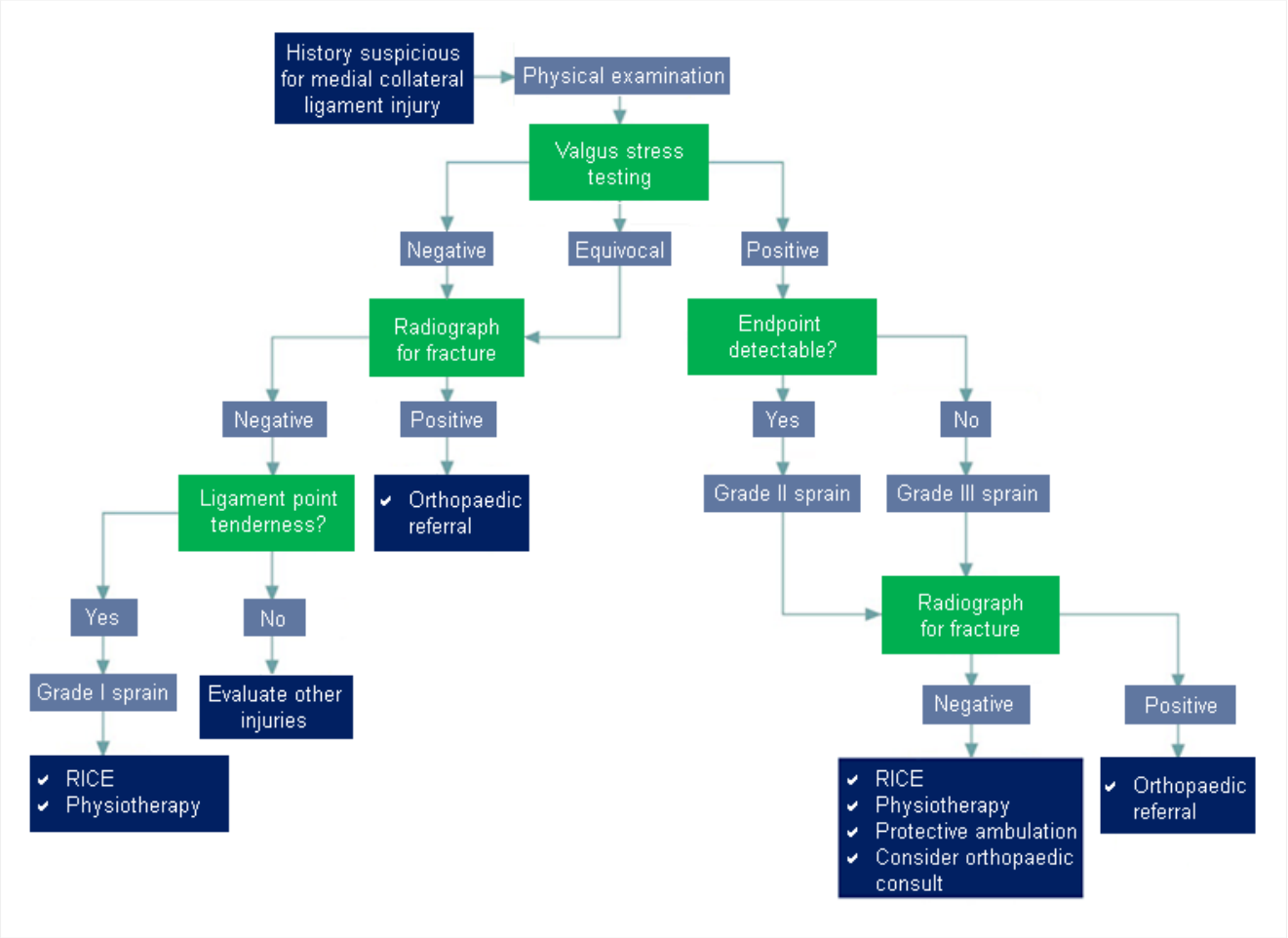


Figure 7: Diagnostic algorithm for medial collateral ligament injuries. RICE: rest, ice, compression, elevation

Created by Sanjeev Bhatia, MD; used with permission

Figure 8: The Lachman's test

From the collection of Sanjeev Bhatia, MD; used with permission

Knee x-ray indications: Ottawa knee rules (acute)

- Age ≥55 years
- Isolated patella tenderness
- Tenderness at head of fibula
- Inability to flex knee 90°
- Inability to bear weight (4 steps) immediately after injury and in emergency department

Figure 9: X-ray indications in acute knee injury: the Ottawa knee rules

Table created by Sanjeev Bhatia, MD. Adapted from Stiell IG, et al. Implementation of the Ottawa knee rule for the use of radiography in acute knee injuries. JAMA. 1997;278:2075-2079

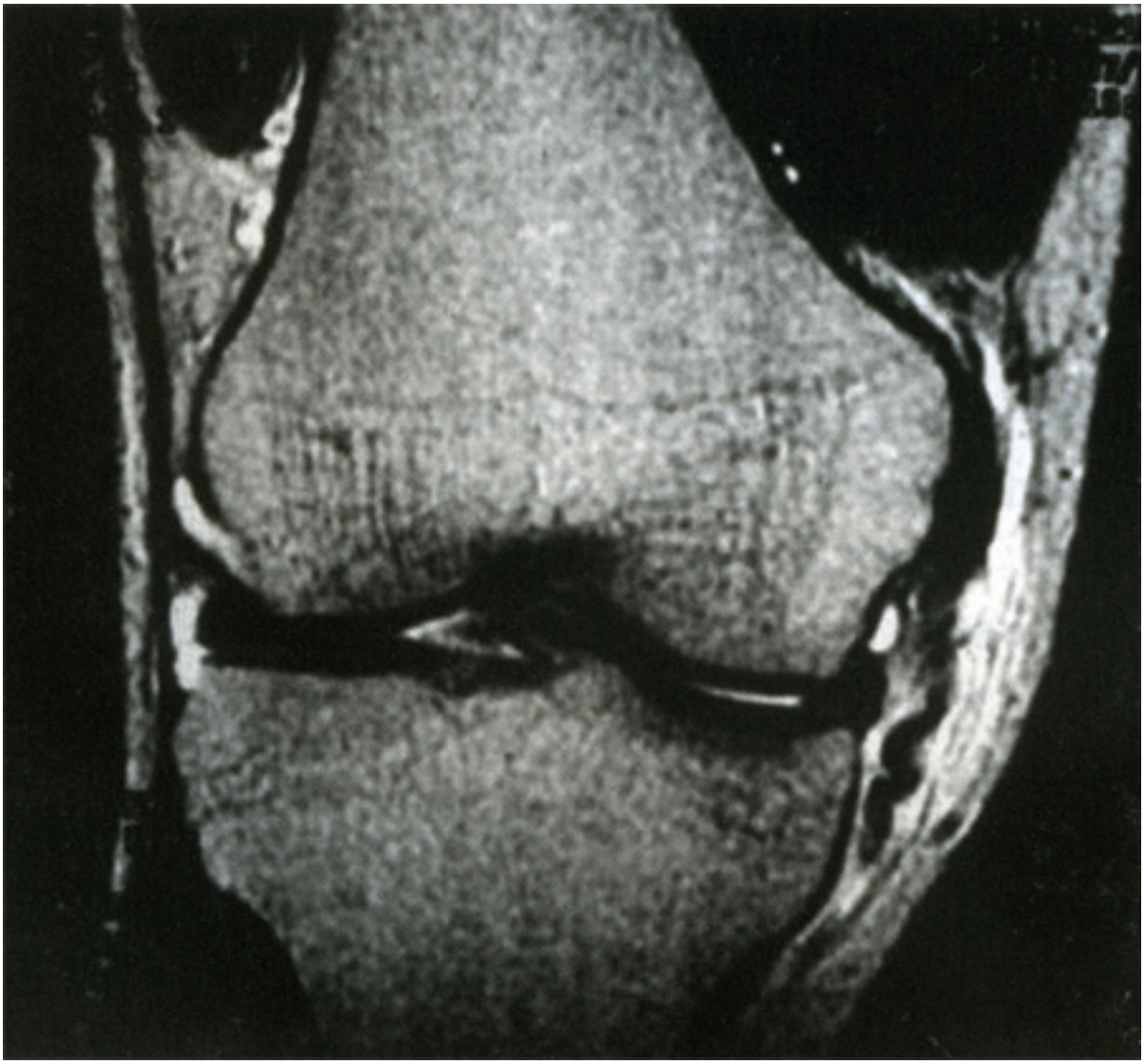
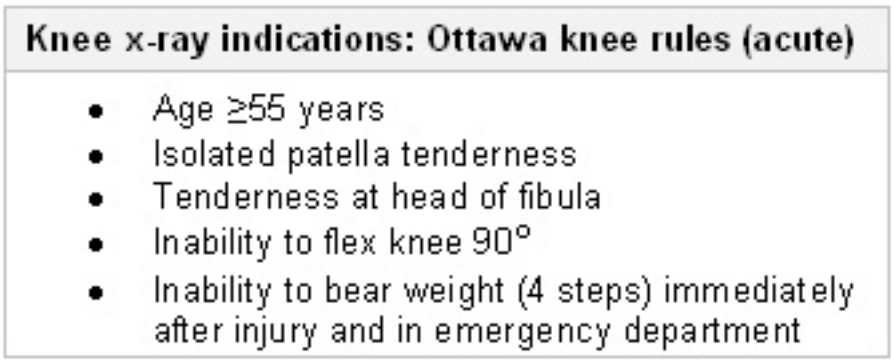


Figure 10: T2-weighted MRI showing a medial collateral ligament injury

From the collection of Sanjeev Bhatia, MD; used with permission



Knee x-ray indications: Ottawa knee rules (acute)

- Age ≥55 years
- Isolated patella tenderness
- Tenderness at head of fibula
- Inability to flex knee 90°
- Inability to bear weight (4 steps) immediately after injury and in emergency department

Figure 11: X-ray indications in acute knee injury: the Ottawa knee rules

Table created by Sanjeev Bhatia, MD. Adapted from Stiell IG, et al. Implementation of the Ottawa knee rule for the use of radiography in acute knee injuries. JAMA. 1997;278:2075-2079

Figure 12: Hinged knee brace

From the collection of Sanjeev Bhatia, MD; used with permission

Disclaimer

BMJ Best Practice is intended for licensed medical professionals. BMJ Publishing Group Ltd (BMJ) does not advocate or endorse the use of any drug or therapy contained within this publication nor does it diagnose patients. As a medical professional you retain full responsibility for the care and treatment of your patients and you should use your own clinical judgement and expertise when using this product.

This content is not intended to cover all possible diagnosis methods, treatments, follow up, drugs and any contraindications or side effects. In addition, since such standards and practices in medicine change as new data become available, you should consult a variety of sources. We strongly recommend that you independently verify specified diagnosis, treatments and follow-up and ensure it is appropriate for your patient within your region. In addition, with respect to prescription medication, you are advised to check the product information sheet accompanying each drug to verify conditions of use and identify any changes in dosage schedule or contraindications, particularly if the drug to be administered is new, infrequently used, or has a narrow therapeutic range. You must always check that drugs referenced are licensed for the specified use and at the specified doses in your region.

Information included in BMJ Best Practice is provided on an “as is” basis without any representations, conditions or warranties that it is accurate and up to date. BMJ and its licensors and licensees assume no responsibility for any aspect of treatment administered to any patients with the aid of this information. To the fullest extent permitted by law, BMJ and its licensors and licensees shall not incur any liability, including without limitation, liability for damages, arising from the content. All conditions, warranties and other terms which might otherwise be implied by the law including, without limitation, the warranties of satisfactory quality, fitness for a particular purpose, use of reasonable care and skill and non-infringement of proprietary rights are excluded.

Where BMJ Best Practice has been translated into a language other than English, BMJ does not warrant the accuracy and reliability of the translations or the content provided by third parties (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages). BMJ is not responsible for any errors and omissions arising from translation and adaptation or otherwise.Where BMJ Best Practice lists drug names, it does so by recommended International Nonproprietary Names (rINNs) only. It is possible that certain drug formularies might refer to the same drugs using different names.

Please note that recommended formulations and doses may differ between drug databases drug names and brands, drug formularies, or locations. A local drug formulary should always be consulted for full prescribing information.

Treatment recommendations in BMJ Best Practice are specific to patient groups. Care is advised when selecting the integrated drug formulary as some treatment recommendations are for adults only, and external links to a paediatric formulary do not necessarily advocate use in children (and vice-versa). Always check that you have selected the correct drug formulary for your patient.

Where your version of BMJ Best Practice does not integrate with a local drug formulary, you should consult a local pharmaceutical database for comprehensive drug information including contraindications, drug interactions, and alternative dosing before prescribing.

DISCLAIMER

Interpretation of numbers

Regardless of the language in which the content is displayed, numerals are displayed according to the original English-language numerical separator standard. For example 4 digit numbers shall not include a comma nor a decimal point; numbers of 5 or more digits shall include commas; and numbers stated to be less than 1 shall be depicted using decimal points. See Figure 1 below for an explanatory table.

BMJ accepts no responsibility for misinterpretation of numbers which comply with this stated numerical separator standard.

This approach is in line with the guidance of the International Bureau of Weights and Measures Service.

Figure 1 – BMJ Best Practice Numeral Style

5-digit numerals: 10,000

4-digit numerals: 1000

numerals < 1: 0.25

Our full website and application terms and conditions can be found here: Website Terms and Conditions.

Contact us

+ 44 (0) 207 111 1105
support@bmj.com

BMJ
BMA House
Tavistock Square
London
WC1H 9JR
UK

Contributors:

// Authors:

Sanjeev Bhatia, MD

Director, Hip & Knee Joint Preservation Center
Northwestern Medicine Central DuPage Hospital, Northwestern University Feinberg School of Medicine, Warrenville, IL
DISCLOSURES: SB receives publication royalties from the following Nova publication: Ligamentous Injuries of the Knee. SB has stock ownership in: AI Digital Ventures, LLC; Edge Surgical; TDA Ventures, LLC; and Joint Preservation Innovations, LLC. SB is on the Board of Directors for AI Digital Ventures, LLC and Joint Preservation Innovations, LLC. He also holds patents pertaining to bone resection related technology. He has received other financial or material support from Smith & Nephew and Graymont Medical, LLC, and has been a paid speaker for the latter. SB also is a board or committee member for the American Academy of Orthopaedic Surgeons and the Arthroscopy Association of North America.

Nikhil N. Verma, MD

Professor
Department of Orthopedic Surgery, Section of Sports Medicine, Rush University Medical Center, Chicago, IL
DISCLOSURES: NNV declares the following competing interests: American Orthopaedic Society for Sports Medicine: board or committee member; American Shoulder and Elbow Surgeons: board or committee member; Arthrex, Inc: research support; Arthroscopy: editorial or governing board; publishing royalties, financial or material support; Arthroscopy Association Learning Center Committee: board or committee member; Arthrosurface: research support; Cymedica: stock or stock options; DJ Orthopaedics: research support; Journal of Knee Surgery: editorial or governing board; Minivasive: paid consultant, stock or stock options; Omeros: stock or stock options; Orthospace: paid consultant; Ossur: research support; SLACK Incorporated: editorial or governing board; Smith & Nephew: IP royalties, paid consultant; Smith & Nephew, Athletico, ConMed Linvatec, Miomed, Mitek: research support; Vindico Medical-Orthopedics Hyperguide: publishing royalties, financial or material support.

// Peer Reviewers:

Jason M. Scopp, MD

Director
Joint Preservation Center at Peninsula Orthopedic Associates, Salisbury, MD
DISCLOSURES: JMS declares that he has no competing interests.