History and Examination of the Knee

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INTRODUCTORY PRINCIPLES

Traditionally, examination of a joint involves the principle 'look, feel, move'. Whilst this adage may still hold true for basic examination of the knee, the order and sequence of examination changes depending on the likely diagnosis suggested by the history. For example when examining a severely arthritic knee it is not necessary to examine for the integrity of the anterior cruciate ligament or to palpate for signs of patella tendinopathy. A more targeted approach is called for.

There are many different individual tests and signs described in the knee and for most of these the sensitivity and specificity has not been adequately reported. Surgeons therefore tend to have a set of primary signs or findings that confirm a particular diagnosis backed up by a set of secondary or confirmatory signs. For example a 'full house' of findings for a torn meniscus is a history of a twisting injury, knee effusion (current or history of) and specific deep tenderness on the postero-medial joint line. In the absence of a 'full house' then confirmatory examination is indicated including McMurray's test, squat duck walking, or palpation in the figure 4 position.

This observation leads on to other points. The full house mentioned above assumes that the patient is in the right broad age group category for the specific diagnosis of meniscal injury and that the diagnosis will lead to an appropriate treatment. It should be remembered that the purpose of history and examination is to lead to a diagnosis that results in a management plan that hopefully leads to patient benefit. This might mean for example sometimes all that is required is a decision whether a patient needs an arthroscopy or not, based on mechanical symptoms, where reaching a specific diagnosis may not be required. Knee examination and radiographs might, for example, show a severely arthritic knee but if the patient has only mild pain then arthroplasty is unlikely to be indicated. Again, history and examination are targeted towards a diagnosis leading to management decisions.

To achieve this, we note that knee problems will present with various characteristic patterns that will lead to the patient being categorised in to a diagnostic box. Specific direct questions may be needed to aid this process. This is not asking 'leading questions' but 'direct questioning' that helps focus the patients mind onto the specific symptoms and the examiner onto specific possible diagnoses. *For example to detect ACL deficiency the specific question 'do you trust your knee?' or 'did you hear a pop at the time of injury?' may need to be asked to lead to that diagnosis.*

This chapter on history and examination of the knee breaks down the process into three parts: history, which leads to a potential group of diagnoses; general knee examination; and targeted knee examination.

A. HISTORY

CLINICAL PRESENTATION

The three key features when addressing a patient with a knee problem are:

- The main symptom: pain, swelling, locking or giving way
- Age of the patient
- Mechanism of onset of problem

Most patients with knee problems will present with one or more of four core symptoms or signs: pain, swelling, locking and giving way. *Each of these symptoms indicate specific types of problems leading to further questioning looking for a particular scenario.*

Younger age is more likely to indicate a traumatic injury or anterior knee pain whereas older age usually indicates an arthritic wear and tear process.

Onset associated with trauma indicates specific injury to the knee anatomical structures where as gradual onset over time indicates a degenerative process.

SYMPTOMS IN DETAIL

Pain

In principle the site, nature, character and severity of pain are determined by specific questions.

General Questions:
- Location (vague widespread suggesting patella-femoral source or localised to medial or lateral joint line)
- Nature (sharp, burning, dull ache etc)
- Exacerbating features (activity related or at rest)
- Pain radiation
- Progress over time (getting worse or better)

Specific Scenarios:
- Pain on medial aspect of knee on deep squatting: indicates a meniscal tear
- Joint pain radiating down leg: indicates arthritic aching process
- Pain at rest: usually indicates severe arthritis
- Pain at night: indicates inflammatory cause
- Pain worse on sitting for prolonged periods or on climbing/descending stairs: indicates patello-femoral problems
- Pain in multiple sites: indicates either a generalised problem or may indicate inappropriate pain response

Swelling

Swelling usually indicates that there is a significant problem in the knee

General questions:
- Relation to onset of symptoms (earlier or late).
- Exacerbating features
- Relieving features

Specific Scenarios:
- Swelling occurring within four hours from pivoting injury: indicates torn anterior cruciate ligament
- Swelling occurring greater than four hours after twisting injury: usually indicates a meniscal tear

- Swelling with activity: usually indicates a degenerative process
- Localised hard swelling on lateral joint line after activity: indicates lateral meniscal cyst from a tear
- Extra articular swelling: indicates a bursa
- Non specific onset: indicates an inflammatory problem
- A very tense and painful swelling following injury: usually means haemarthrosis and a more significant injury

Locking

This means the transient inability of the leg to go out straight rather than difficulty in flexing the knee. It is important to distinguish this from pseudo locking following medial collateral injury where extension is limited by pain.

General Questions:
- Exacerbating factors (squatting, twisting etc)
- Relieving factors
- Exact description of locking (asking the patient what they mean by locking)
- Permanently blocked or intermittent
- True meniscal locking or false patella catching

Specific Scenarios:
- Intermittent locking of the knee relieved by shaking the leg or a trick manoeuvre: indicates a loose body
- Inability to fully straighten the leg at any time following trauma: indicates a meniscal tear, osteochondral fragment or ACL stump blocking full extension
- Transient locking on standing: may indicate catching of the worn arthritic surfaces

Giving Way

Giving way can also be described as buckling, not trusting the knee or giving out.

General Questions:
- Movements associated with the giving way (pivoting movements, straight line activities or descending stairs)
- Description of giving way sensation (twisting knuckles sign or patella giving way)
- Relation to pain (pain before or after giving way)

Specific Scenarios:
- Rotational giving way mimicked by twisted knuckles: indicates ACL deficiency
- Knee giving way on pivoting to one side and feeling of patella jumping: indicates patella dislocation
- Knee giving way on squatting associated with medial pain: indicates meniscal tear
- Knee giving way on stairs with falling over: indicates patella dislocation. With ACL type giving way the patient is usually able to catch themselves
- Giving way after pain: usually due to quads inhibition associated with pain from the catching of worn surfaces

Additional clinical features to elicit

Other specific detail is required to lead to an action plan and these include:

Noises and sensations in the joint:

- A feeling of something moving around indicates a loose body
- A painful grating sensation indicates crepitus and possible damage to the joint surface
- A thudding clunk usually indicates a meniscal tear catching or relocating

Severity of the symptoms in relation to lifestyle:

- For the active individual this means sporting aims and desired activity levels.
- For the arthritic assessment this means walking distance, ability to climb stairs, night waking and interference with quality of life.

Conclusion of history

After taking the history then there should be a fairly good idea of the diagnosis or, if not likely diagnoses, then the main category of problem.

Essentially the patient will be in one of four main categories:

- Anterior knee pain
- Traumatic injury to knee ligaments, meniscus or other structures
- Degenerative osteoarthritis
- Inflammatory joint problem

B. EXAMINATION

Examination starts with a general examination of the knee followed by specific examination to confirm a specific diagnosis that has been indicated by the history. The history and examination should lead to a management plan that may involve further targeted investigations.

General examination includes assessing the patient standing, walking and lying supine, and includes active, passive and provocative tests or movements. This should allow specific examination to concentrate on one of fours areas:

- The patello-femoral joint and extensor mechanism
- Meniscal pathology
- Ligament stability
- Arthritis

1. General examination

a. Standing and walking

This includes general habitus, leg alignment, posture, change in alignment on walking, the presence of an antalgic hip gait and muscle wasting. Looking at the leg starts as the patient walks in to the clinic and takes in to account their general demeanour, appearance, manner of walking and mobility around the examination area. All these factors add information to the diagnostic equation.

In normally aligned legs, with the patellae pointing forwards, the knee and ankles should be gently touching together (FIG 1).

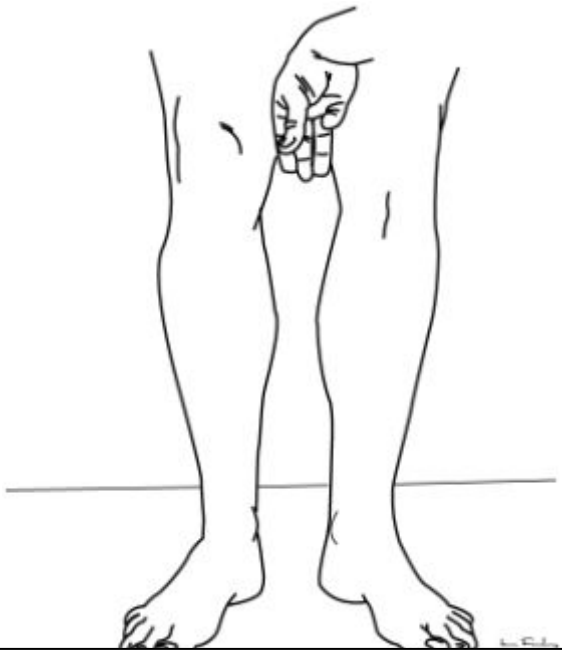


Fig 1. Examination for leg alignment in the static standing position

Varus (bowlegged) or valgus (knock-kneed) alignment is noted and the presence of increasing deformity as a lateral or medial thrust on walking is also checked for (FIG 2).

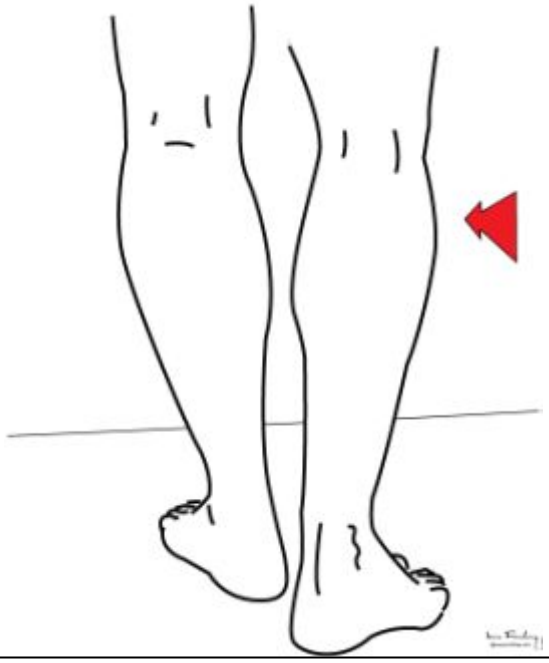


Fig 2. Lateral thrust of the Right knee on walking, indicating malalignment.

Mal-alignment may also be rotational. In normally aligned legs when the patella points forward then the feet should also point forward, nearly in parallel. There is clearly a wide range of what is normal and mild varus or hyperextension, for example, may be a physiological variant of normal.

Squinting patellae occur when the feet point forward but the knees squint towards each other representing abnormal femoral and tibial torsion. Isolated external tibial torsion may be noted if the patella points forward but the feet point outwards more than 10 –15^0.

If the patients' complains of instability then it may be useful to ask the patient to demonstrate the direction they feel the knee moves into. This may elicit lateral or postero-lateral instability.

b. Supine

Examination supine involves a combination of look, feel and move. In order to look properly we need to feel the knee aiming to detect and confirm specific appearances and problems.

- **General inspection:** This takes into account evaluating alignment, position of the knee, skin problems, scars, muscle wasting, bruising for site of trauma, and the manner in which the knee is held.

- **Presence of effusion**: This may be obvious due to loss of the usual divot or dent on the medial aspect of the patella or it may need to be detected by the **bulge test**. In this test the flat palm of the examiners hand milks fluid from the medial side via the suprapatella pouch into the lateral gutter. This collection of fluid is then sharply pushed back to the medial side by stroking the lateral gutter with the back of the hand eliciting a bulge on the medial side. Squeezing the suprapatella pouch with one hand and balloting the patella may elicit the **patella tap sign** (FIG 3).

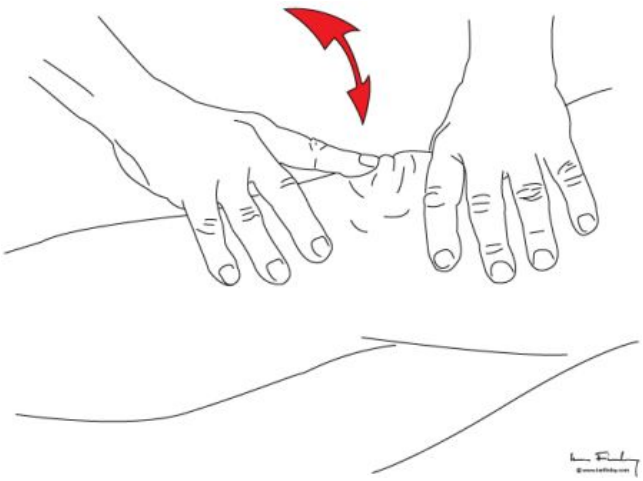


Fig 3. Patella tap sign, bouncing the patella off the trochlea to demonstrate effusion

- **Fixed flexion deformity:** The patient may be holding the knee in a flexed posture indicating true locking or pseudo locking due to pain. The knee can be gently straightened to full hyperextension looking for any loss compared to the other side. Full passive extension is determined by holding the knee flat and lifting the foot and heel off the couch – quantifying any difference between the two knees by number of fingerbreadths heel height difference. An alternative measure is heel height difference in cm on prone lying with the distal thigh supported by the couch (FIG 4).

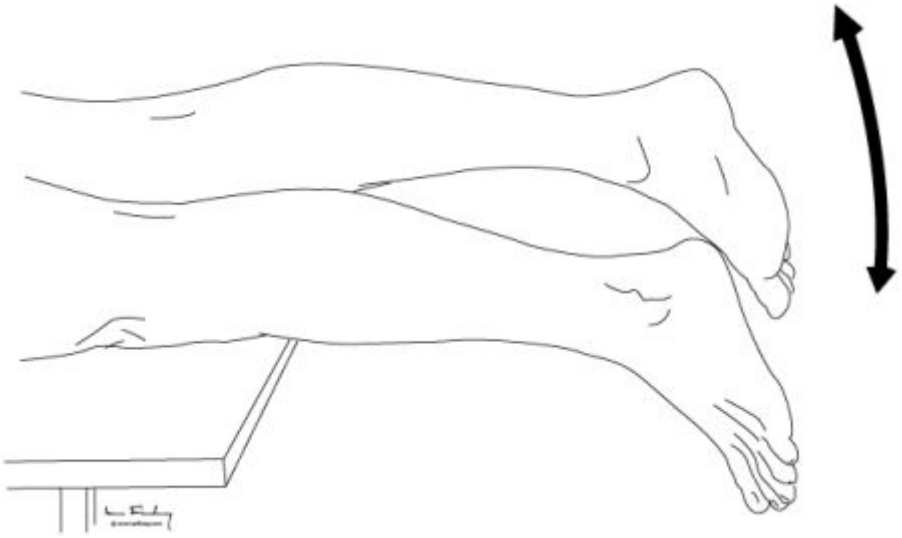


Fig 4. Measuring heel height difference in prone lying to record loss of knee extension

- **Assessing extension in the acutely injured knee:** In the acute phase initially resting the knee over a pillow to encourage the muscles to relax and then gradually lifting the heel off the couch can allow detection of any true loss of extension. Pain felt over the medial aspect while achieving full extension indicates MCL injury rather than meniscal locking. Simply holding the legs by the heels may also detect a difference in knee height.

- **Range of movement (ROM):** After trying to detect loss of extension it is useful at this stage to examine for flexion, partly because the patient is expecting the knee to be moved but mainly because this will elicit how painful the knee is and therefore guide the remainder of the examination. In the obviously arthritic knee, range of movement is the most important sign and palpation of tender points less so. By convention ROM is expressed by three numbers: hyperextension or recurvatum, active extension and flexion eg 5/0/135.

2. Specific examination

a. The patello-femoral joint and extensor mechanism

Inspection of the patello-femoral joint is initially best performed with the patient sitting with the leg flexed over the edge of the couch, noting the following features or signs.

- **Position of the patellae**: The patella normally faces forward and slightly up. Facing higher indicates patella alta, and lower indicates patella baja.

- **Position of the tibial tubercle:** This should be directly inferior to the centre of the patella. Inspection gives a guide to the tibial tubercle trochlea groove (TT-TG) offset that is more formally quantified on CT or MRI scanning.

- **Patella tracking:** On active extension the patella should track centrally toward the groin. Tracking laterally in extension as an inverted J-sign indicates lateral subluxation in extension and potential or real patella instability.

- **Feeling the articulation:** Holding the hand gently over the patella detects crepitus.

With the patient lying supine the following tests can be performed:

- **Detection of effusion:** This has been previously described

- **Palpation for tender points:**
  - Tibial tubercle for Osgood Schlatters
  - Lower pole patella for patella tendinopathy (jumpers knee) or Johansson-Sindig-Larsen syndrome in the adolescent. This is best examined by tilting the patella from superior and pushing into the lower pole with the thumb
  - Superior pole of the patella for quads tendinopathy.
  - Tenderness on the medial or lateral border of patella
  - Any specific trigger points looking for neuroma or tender nodules
  - Medial retinaculum for tenderness over the medial plica, felt as a chord on rolling the finger against the condyle (with the knee in extension)
  - Excessive patella tilt by holding the axis of the patella between finger and thumb.

- **Movements of the patella:**
  - Patella glide is quantified as the proportion of patella width that it can move medially or laterally in either full extension or at 30 degrees flexion (FIG 5). There is debate as to what is actually normal.



Fig 5. Assessment of patella mobility by medial and lateral glide, expressed as a proportion of patella width that the patella moves.

  - Apprehension sign. Detected by gently trying to dislocate the patella laterally, eliciting an obvious sense of apprehension by the patient. Many patients with patella instability are extremely nervous when their patella is even just approached by the examiner and this should be noted (FIG 6).

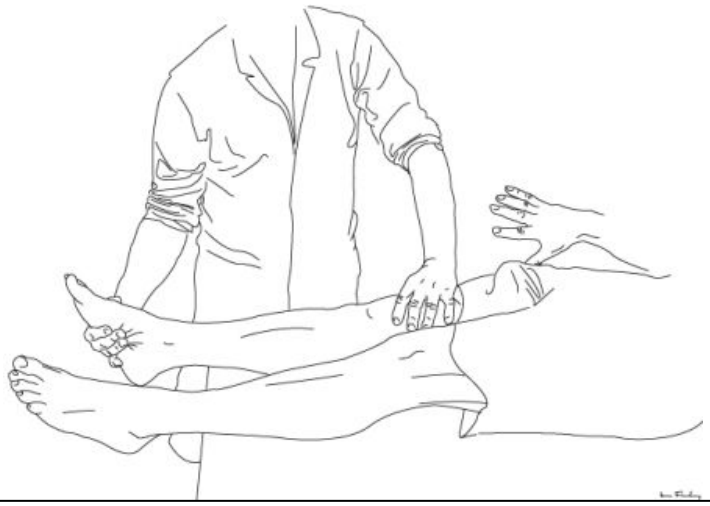


Fig 6. The apprehension sign, illustrating nervousness of the patient when attempted subluxation is gently performed

- Patello-femoral compression. Examined by compressing the patella into the groove and rocking the knee into flexion and extension, eliciting pain, catching, crepitus or bare-bone grinding.
- Patella tendon movements. Tethering of the patella to the anterior tibia will reduce medial/lateral movement of the patella tendon.

With the knee flexed at 90º, the knee is further examined.

- **Palpation for trigger points (FIG 7)**
  - Fat pad tenderness either side of the patella tendon
  - Lateral IT band syndrome. Deep tenderness 2cm proximal to the lateral joint line over the lateral epicondyle. This is then confirmed with the patient standing, facing away from the examiner and palpating over the lateral epicondyle while asking the patient to mini squat.
  - Capsular irritation over a prominent osteophytic edge of the articular surface may be noted
  - Tender nodules or points representing a neuroma or painful scar

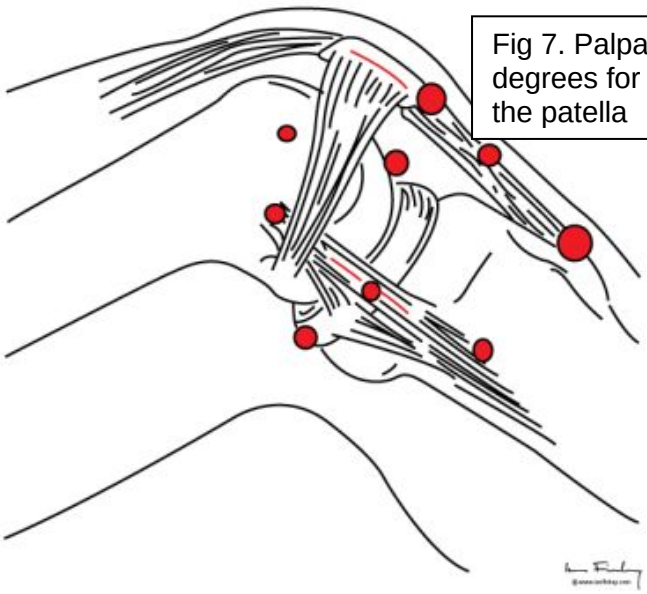


Fig 7. Palpation of the knee at 90 degrees for trigger points around the patella

b. Examination of the menisci

This is best performed with the knee flexed at 90 degrees**.** Both hands may be needed to palpate the specific trigger points around the knee while supporting the leg with the other hand. It is useful to ask the patient to indicate where the pain is felt, as meniscal problems tend to be point specific where as degenerative problems are more vague in distribution.

- **Palpation**
  - **Meniscal tenderness:** Palpation for tender trigger points involves targeted pressure over specific areas. Meniscal tenderness is particularly deep and therefore takes a fair amount of force, usually pushing the pulp of two fingers or sometimes the thumb to elicit the pain.
    - Medial meniscal tenderness is classically on the postero medial part of the joint line (FIG 8).

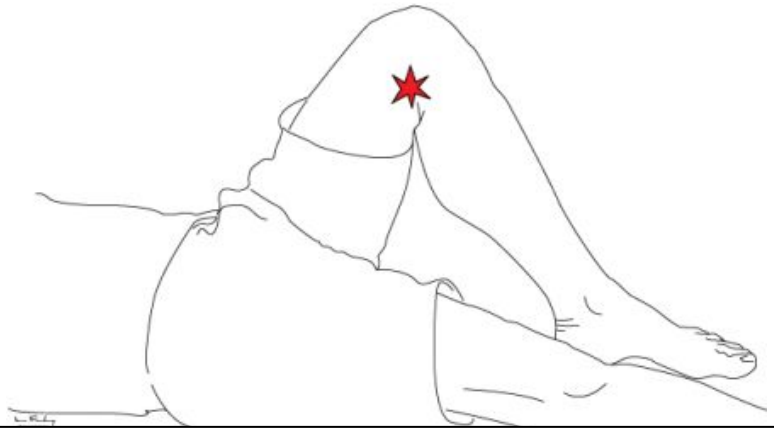


Fig 8. Medial joint line tenderness – felt at the posteromedial part

    - Lateral meniscal tear tenderness is on the mid lateral aspect (FIG 9).



Fig 9. Lateral joint line tenderness is felt in the mid lateral part of the joint, also by deep firm palpation

    - Anterior joint line tenderness may indicate a bucket handle tear, especially if associated with a block to full extension

- **Swelling:** An associated fullness or obvious swelling may be sensed due to either an associated cyst (usually lateral) or sometimes the flap of a meniscus (typically medial). Lateral meniscal cysts stay at the level of the joint line and tend to be very hard – enough to be mistaken for bony lumps. Medial cysts tend to be just below the joint line.

- **Pain on movement**
  - **Meniscal pain on full flexion**. Pressure on the meniscus is increased in full flexion and may be resisted by the patient

  - **McMurrays test**. In this test rotation in forced flexion with compression over the medial joint line is positive if it elicits a clunk from a torn meniscus as the test was originally described. It is less reliable if used with simple detection of pain. (FIG 10).



Fig 10. McMurrays test performed holding the knee to achieve full flexion and by applying rotational movements by grasping the heel.

  - **Squat or duck walking.** This mimics McMurrays manoeuvre, compressing the menisci in deep flexion. The patient is asked to squat and walk or waddle a few steps, eliciting their characteristic pain. This can be a very useful confirmatory test.

  - **Apleys grind test.** This is less commonly used but the patient is positioned prone, the knee flexed to 90^0 and the tibia ground into the femur looking for pain from a meniscal tear.

c. Examination for ligament instability

- The following ligaments or ligament complexes can be examined individually or in combination and the pattern of instability determined:
- Collateral ligaments
- Anterior Cruciate ligament
- Posterior Cruciate ligament
- Postero lateral corner
- Postero-medial corner

i) Collateral ligament examination

Understanding the anatomical structure and attachments of the collateral ligaments is important for accurate examination. The MCL is a fan shaped ligament radiating from the medial epicondyle on the femur to a broad attachment on the tibia whereas the LCL is a cord like structure from the lateral epicondyle to the head of the fibula. Tenderness following acute injury is examined with the knee at 90^0, applying deep palpation over the epicondyles and, for the MCL, over the tibial attachment.

Laxity and pain on stressing the collateral ligaments is detected at full hyperextension, 0 degrees extension and at 30 degrees with the purpose of detecting a difference to the other side. The patient should be asked whether the movement feels the same.

For detection of movement the knee is cupped by one hand using the fingers and the palm alternately as a fulcrum against the epicondyles, and the leg is levered to the side by firmly grasping the heel (FIG 11). Sometimes there is a clunk when pressure on the leg is removed and the joint closes again, reproducing any characteristic feeling of instability. Flexion beyond 20 - 30 degrees will result in rotation at the hip rather than opening of the knee.

Integrity of the LCL can be checked by palpation in the 'figure four' position, feeling the chord like structure running from fibula head to femur.

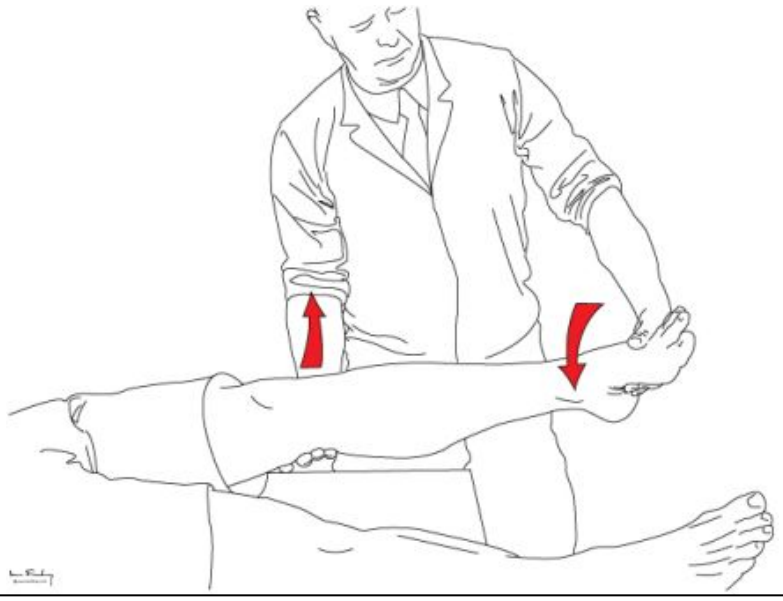


Fig 11. Assessment of the collateral ligaments, achieved by cupping the knee and then applying medial and lateral movements of the leg by grasping the heel. The fingers and the palm are used as a fulcrum.

ii) Anterior Cruciate ligament examination

Again the purpose of examining the ligament is to detect asymmetry with the other side. Various methods need to be known in trying to get the patient to relax. Traditionally it is thought that it is difficult to diagnose ACL insufficiency in the awake patient due to voluntary and involuntary contraction of the hamstring tendons, which act as the main posterior dynamic restraint to the knee. This section outlines the detailed method for accurately detecting laxity of the ACL but, of course laxity may not necessarily mean that the patient has a non-functional ACL.

TABLE: Tips to encourage a patient to relax for ligament examination

- Resting the knee over a pillow at 10 – 15 degrees – this is useful in the acute injury stage as it keeps the thigh supported.
- Using a multitude of words of encouragement, not just relax!, relax!, relax!, expressed by the examiner with increasing anger.
- Repeated examination coming back to the stability tests after completing other parts of the examination
- Resting the patient in such a way that the patient can still see what is happening to their knee. They are naturally anxious, know it hurts, and actively lifting the head increases quads and hamstring activity.
- Repeatedly put the knee down and roll it on the couch to encourage the muscles to let go.
- Distraction with conversation

Lachmans test

This detects increased AP movement in the knee at 10 – 15 degrees flexion i.e. when the posterior aspect of the knee is held a hands breadth off the couch. Fig 12 shows positioning of the hands to exact a true anterior pull of the tibia on the femur, avoiding any rotational pull. The fingers of the lower hand should be directly posterior and the thumb of the upper hand directly anterior. The patient is encouraged to relax and firm AP force is applied, pushing back with the thigh hand and pulling forward with the tibial hand.

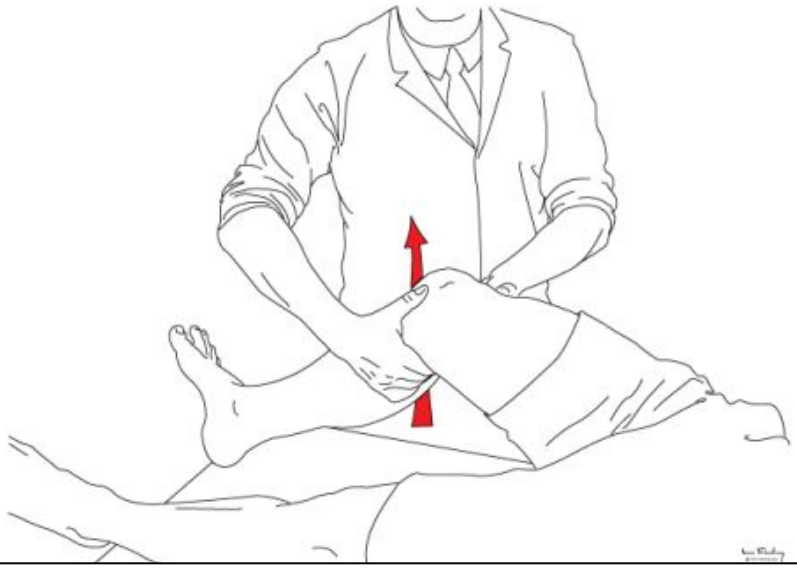


Fig 12. Lachman's test: the thumb and fingers of each hand, placed as near to the mid line as possible, grip the leg in order to achieve direct anterior and posterior movement. A difference between the two sides in terms of endpoint or excursion is all that is required to indicate ACL injury.

The test detects a difference between the two knees, assuming the other knee is innocent. The patient will often be able to tell the examiner if there is a difference. Two differences are sought:

- Increased anterior movement – it doesn't matter how much, just that it is different to the other knee

- Quality of the end point: hard end point, indicating some fibres may be intact, or soft endpoint.

If the thigh is too big for the examiners hand then the thigh can be supported over the examiners own flexed knee at the same 15 degree flexion position. The thigh hand is then clamped on top of the patients thigh and the tibial hand used to exert the anterior force.

Pivot shift test

The pivot shift test is pathogmonic of ACL deficiency. In patients with recurrent giving way due to ACL injury it reminds them of the unpleasant feeling and this expression needs to be asked for, sometimes by asking the direct question 'does this reproduce *your* feeling of instability?'

Various methods have been described and all involve supporting the tibia, applying valgus stress and flexing or extending the knee. Without adequate support the test can be very painful prohibiting either the first go or certainly any other attempt.

The method described here is painless and easily reproducible. It takes into account an understanding of the function of the ACL and three key observations:

- Abnormal sliding of the tibia on the femur occurs at around 20 degrees of flexion, not any more.
- The patient can relax their hamstrings by actively extending the knee contracting the quads,
- With the tibia adequately supported, the femur can drop posteriorly away from the tibia

Technique of the Patient Assisted Pivot shift test

Fig 13 shows how the tibia is supported, between the examiners side and over the examiners forearm. The hand is then interlocked over the wrist of the other hand, which is applied against the lateral aspect of the proximal tibia and fibula. This is an active test involving participation of the patient. Initially their confidence is obtained by asking them to flex their knee from extension without the examiner applying any force on the leg.

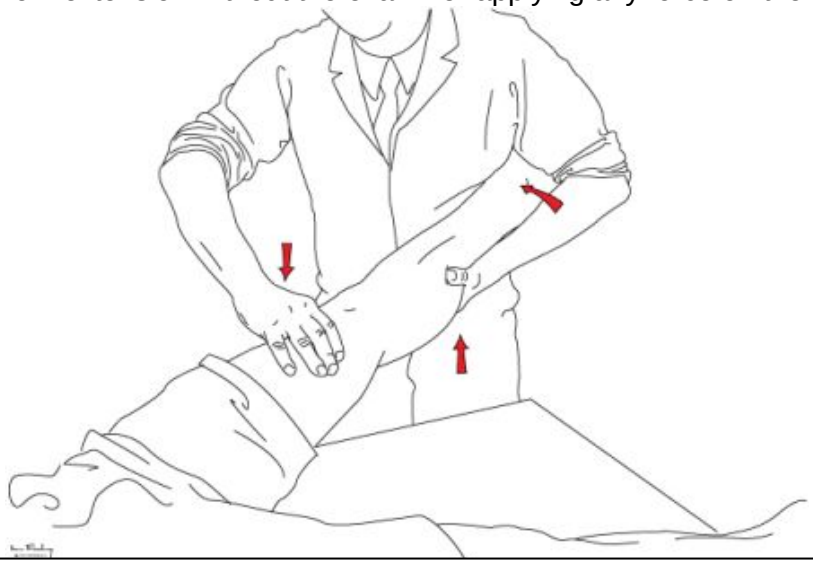


Fig 13. Pivot shift test - see text for description: ideally the arms need to be shown in such a way that the examiners left hand goes under the shin of the patient and interlocks on the right wrist and forearm

Once the patient is comfortable the examiner then flexes the passive leg by lifting from the patients posterior calf. This exerts an anterior force on the tibia at the knee and in a positive test the tibia is felt to slide or jump back into place as the knee bends. This can be an obvious clunk or a subtle glide. To emphasise the test looking for reproduction of the patients distrust of their knee, increasing load is applied, both in valgus and by in-line compression, loading the lateral compartment to exaggerate the sliding of the femur over the dome of the lateral tibial plateau.

To encourage the patient to relax their hamstrings and to allow the femur to fall posteriorly, the patient is asked to push down on their knee straightening it. As it goes nearly straight the hamstrings have to relax and the examiner can push up again on the tibia eliciting the subluxation of the tibia on the femur as it goes back into flexion.

Anterior draw test

This test, in which the tibia is pulled anteriorly with the knee at 90 degrees (FIG 14), is much less reliable in the detection of ACL insufficiency. Probably its main purpose is to position the knee so that the step off sign for PCL insufficiency and posterior sag can be detected (see later section). The examiner sits against the foot and the palms grip the sides of the tibia exerting a strong anterior pull. The index fingers of both hands are used to 'knock out' posterior pull by the hamstrings. As for the Lachmans test, it is the difference from the other side that is important.

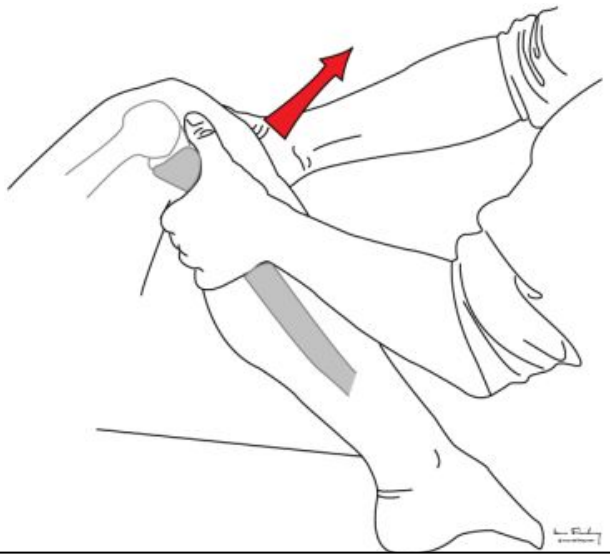


Fig 14. Anterior Draw test. The examiner sits just against the foot and exerts anterior pull on the tibia, holding the hamstrings out of the way with the index fingers while gripping the tibia with the palm of the hands

Active quads test

In this test the thigh is supported on a support such as a rolled up towel and the examiner gently holds the foot on the couch. The patient is asked to try to lift the foot off the couch and the tibia is seen to move anteriorly. Though very useful in the acutely injured knee this test is also positive in PCL injury as the tibia is pulled forward into its normal position.

iii) Posterior Cruciate Ligament examination

The Posterior Cruciate ligament acts to resist posterior translation of the tibia. Laxity is best examined with the knee at 90 degrees.

Posterior sag

When both knees are viewed from the side, any sagging back of the tibial tubercle and upper tibia is noted as posterior sag. A straight edge such as an X-ray packet may be useful to demonstrate subtle sag (FIG 15). The edge is placed against the tibia just above the ankle and on the tibial tubercle. There should usually be a gap between the straight edge and the patella - any difference between the two knees indicates posterior sag.



Fig 15 X-ray packet sign showing normal gap between the edge and the patella (b) and the loss of gap (c) in PCL insufficiency

Posterior draw test

With the knee at 80^0 – 90^0 degrees the tibia is pushed posteriorly to detect any increased posterior translation (FIG 16). The tibia needs to be pulled anteriorly to detect a firm endpoint from the ACL and to determine a starting point for the tibia otherwise, especially in chronic laxity the tibia tends to sit as far posteriorly as it can.



Fig 16. Posterior draw test. The tibia is pushed posteriorly and the thumb is used to feel the step off between the tibial margin and the exposed articular end of the Femur

The step off sign

This is perhaps the most useful sign in detecting PCL laxity as it also helps to determine treatment. FIG 17 shoes the three grades based on the observation that as the examiners thumb is slid up the tibia there is usually a step-off 'down' to the anterior aspect of the exposed medial aspect of the femur. Grade II means the tibia is flush with the femur. The importance is that when grade III is detected (tibia posterior to femur) there is likely to be injury to the posterolateral corner. Note that this test was described by LARSON as a step 'off' and not a step 'on'.

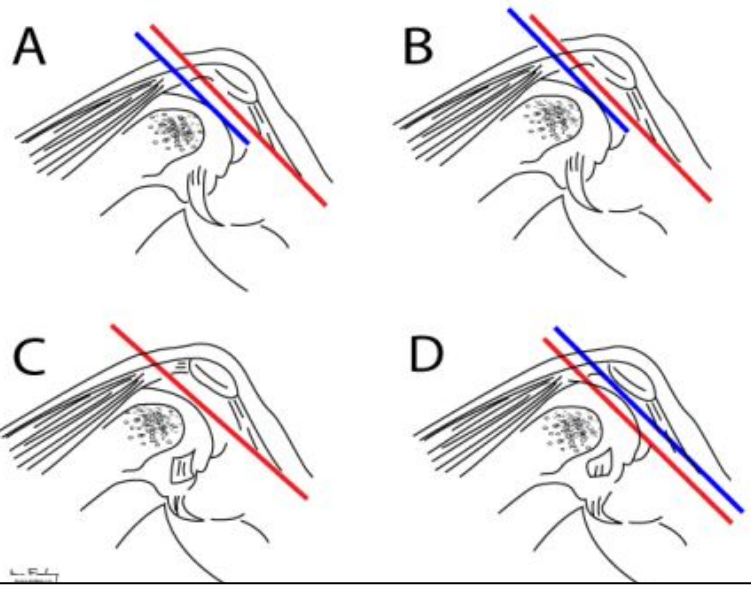


Fig 17. The Step off sign classification in determining the amount of loss of the normal anterior position of the tibia in relation to the femur

Posterior lachmans test

Increased posterior sag can also be detected at 15^0 – 20^0 flexion when the tibia is pushed posteriorly in relation to the femur.

iv) Postero-lateral corner examination

Injuries to structures of the postero-lateral corner results in increased external rotation of the tibia on the femur. Injuries can be isolated or in conjunction with PCL or ACL injury. Examination of this area is not easy and often the results of several tests are assimilated to decide on the final picture. The tests are unfortunately very subjective and are not easily taught. Different examiners provide differing amounts of rotational force and it is often difference in the quality of the end point of movement that indicates abnormality.

Dial test at 30^0 and 90^0

This is probably the easiest way to detect increased external rotation. The patient can be supine or prone (FIG 18), but prone is probably more accurate. The examiner supports the feet while an assistant keeps the knees together, to eliminate femoral rotation. The feet are rotated externally with equal force and the resultant 'dialed' position is then noted, looking for greater than 15 degrees difference to register as abnormal. Any element of rotation at the mid foot is minimised by trying to keep the ankle at neutral and by gripping the hind foot. The test needs to be performed at both 30 and 90 degrees of knee flexion.

Increased external rotation at 30 degrees suggests an isolated postero-lateral corner injury whilst increased external rotation at 30 and 90 degrees suggests injuries to both the postero-lateral corner and posterior cruciate ligament.

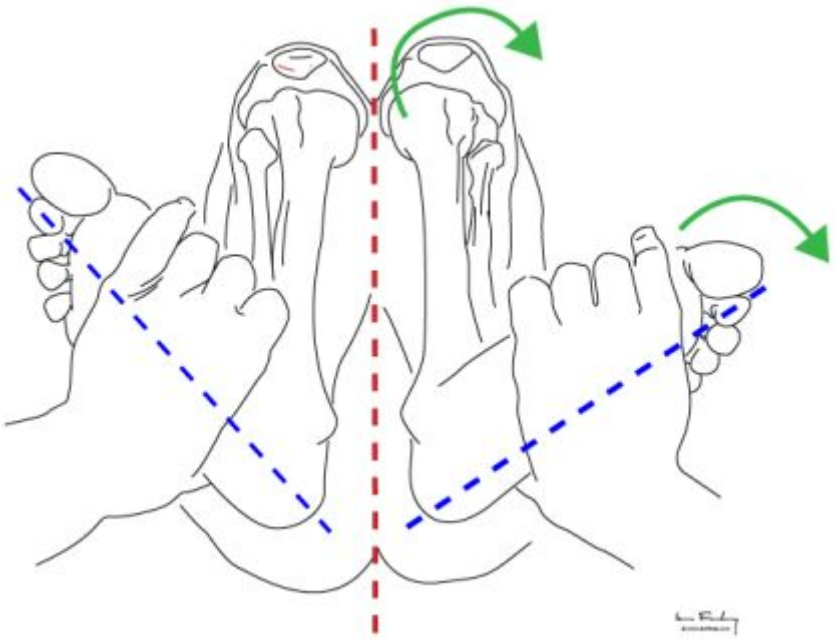


Fig 18. Dial test demonstrating increased external rotation of the left tibia at the knee joint

Lateral hypermobility at 90^0

With the knee at 90^0 the knee is rotated by gripping the proximal tibio-fibular joint and pushing it posteriorly in order to detect an increase in mobility compared to the other side joint. This indicates increased postero-lateral mobility of the knee. **(Fig 19)**



Fig 19. Testing increased rotation externally of the tibia by rotating the tibia and noting the position of the tibial tubercle and the fibula head

Spin test

This is similar to the dial test but is performed with the patient sitting on the edge of the couch. The examiner spins out the tibia while the patient keeps their knees together. Again the aim is to detect increased postero-lateral rotation by feeling and looking at the superior tibio-fibular joint.

External rotation recurvatum test

When the legs are picked up by the big toe or forefoot then the knees should sag back equally. If the PCL and postero-lateral corner are stretched out then the tibia falls into external rotation as the knee goes into hyperextension (Fig 20).



Fig 20. External Recurvatum test: the leg is picked up by holding just the big toe and the knee is seen to drop into varus, external rotation and hyperextension, indicating injury to the postero-lateral structures

Reverse pivot shift test

This test detects the opposite of the pivot shift phenomenon in PCL insufficiency. The knee is supported in flexion with the foot externally rotated and the knee in compression and valgus. On moving into extension the lateral compartment reduces under the femur with a clunk (FIG 21). This is a difficult test to perform reliably.

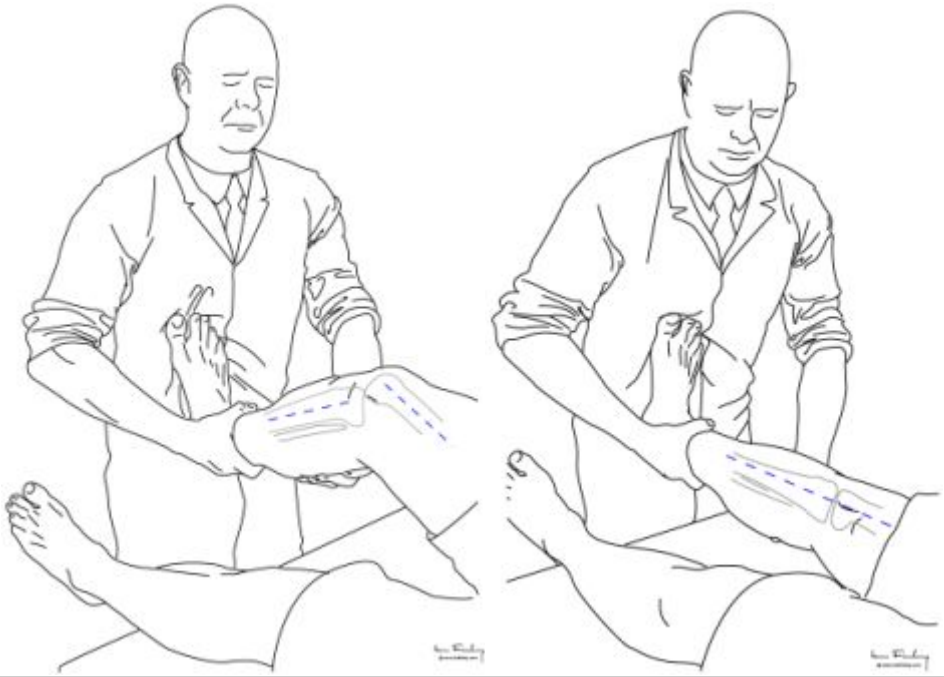


Fig 21. Reverse pivot shift test: the is the opposite of the test for ACL deficiency and the tibia is held in external rotation to detect posterior subluxation of the tibia on bending, and relocation on straightening

d. Examination for arthritis or joint surface damage

The hallmark signs when examining for joint surface damage are signs associated with higher friction, felt on moving one joint surface on its opposing surface under compression.

Fine crepitus

Crepitus on joint movement can be heard but it usually needs to be felt. Active movement loads the joint and the examiner places a hand over the moving part, either feeling with the fingers or the flat of the palm.

Other noises

Popping, snapping or clunking may be felt on movement under load. The characteristic of these noises needs to be noted with specific reference to whether the sensations remind the patient of their symptoms. Many knees will make some form of noise on moving and painless noises are generally considered ‘safe’.

Bare Bone crepitus.

When two bare bone surfaces are forcibly compressed together then there is very high friction and the surfaces momentarily stick together before sliding in a juddering fashion. This sign has been described as the pepper mill sign for obvious analogous reasons. When the patient admits this is what happens when getting up from a chair or on stooping, giving them a feeling of not trusting the knee, then it confirms the extent of their osteoarthritis – even if subsequent x-rays still seem to show the presence of a gap between the surfaces.

It is worth remembering that on the medial compartment the worn surface is most at about 30 degrees flexion, in the lateral compartment wear is at slightly greater flexion. In the patello-femoral joint it is the lateral patella facet and trochlea groove that are most commonly affected.

- **Patello-femoral compartment:** the patella is compressed into the groove and the knee gently rocked by flexing and extending at 10 – 30 degrees, or the patella is moved medially/laterally while compressing.

- **Medial compartment:** the leg is brought into hip abduction, external rotation and 30 degrees knee flexion, resting the knee against the examiners hip for counter pressure. The patients foot is cupped in one hand and the flat palm of the examiners other hand is then used to both sense grating and to hold the knee against the examiners hip. Firm varus force is then applied to the knee and the joint slowly flexed. The key to this test is to allow the bony surfaces to 'stick' together by holding the knee still for 10 seconds or so before initiating very slow bending or straightening. What is happening is that the thin synovial fluid is being compressed out of the articulation removing any oily lubrication benefit.

- **Lateral compartment**: to detect bare bone crepitus laterally the tibia is supported between the examiners elbow and side, while the opposite palm is placed against the lateral joint line with the knee bent at 45^0. Valgus force is applied and very slow flexion initiated trying to detect the surfaces catching.

Range of movement

Loss of range of movement, both flexion and extension is an early sign of joint degeneration. For consistency and accuracy it is best to measure flexion with the patient reclined nearly supine in order to avoid hip flexion, which may increase knee flexion.

Palpation of the joint surface with knee at 90^0

When the knee is at 90^0 the distal articular surface of the medial femoral condyle is facing distally and is not covered by the patella. Deep tenderness on palpation of this surface is consistent with articular surface damage.

Popliteal cysts

Cysts and fullness in the popliteal fossa are best seen and palpated with the knee in extension and when standing.

SUMMARY

History and examination are linked and specific examination is substantially determined by the likely diagnosis or group of diagnoses indicated by the history. That said it is important to undertake general examination of the knee taking into account appearance and examination with the patient, walking, standing, sitting and lying supine.

The various specific signs can be grouped together creating a pattern indicating a specific diagnosis.

Table 1: groups of diagnostic signs

Diagnosis or Disorder	**Signs**
ACL Insufficiency	Lachman test +, Pivot shift +
Posterior instability	Reverse Lachmans test +, Posterior Draw +, Step off sign (grading)
Postero-lateral corner insufficiency	Prone Dial test +, Spin test +, Reverse pivot shift test +/-, Lateral knee thrust on walking
Knee arthritis (medial or lateral compartment)	Loss of range of movement, Bare bone crepitus.
Patella instability	Poor patella tracking, patella apprehension test +, increased patella glide
Medial meniscus tear	Effusion +, posteromedial joint line tenderness, McMurray test +, pain on squat walking
Lateral meniscus tear	Mid lateral joint line tenderness
Patello-femoral arthritis	Effusion, Pain on patello-femoral compression, crepitus felt on extending against gravity
Global anterior knee pain syndrome	Normal alignment tests, crepitus -, patella tendinopathy tests -.

Key Learning points:

- History and examination of the knee are linked and specific examination is determined by the likely diagnosis indicated by the history.
- The 5 diagnostics groups are: Anterior knee pain; Traumatic injury to knee ligaments, meniscus, or other structures; Degenerative osteoarthritis; Inflammatory joint problem; and other problems.
- General examination of the knee is still required with the patient, walking, standing, sitting and lying supine.
- Specific examination is targeted to 4 areas: The patello-femoral joint and extensor mechanism; Meniscal pathology; Ligament stability; and Arthritis. The pattern of signs elicited should lead to definitive diagnosis.