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# Clinical examination of the sprained knee

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**Abstract**

*Introduction*. Patients with knee injuries may be consulted in a first stage by specialists, such as the sports doctor, and in a second stage, depending on the severity of the injury and the therapeutic orientation, it may be necessary to consult an orthopedic surgeon and / or medical rehabilitation.
*Aim.* Particularly important in the traumatic pathology of the knee is the physical examination. It must be rigorous and systematic, because, based on it, a correct diagnosis can be established, which also assesses the severity of the lesions. Only in this way the optimal therapeutic decision be made in order to establish an accurate initial diagnosis and to evaluate the severity of the sprain, depending on which medical or orthopedic-surgical treatment is decided.
*Methods*. Complete and accurate physical examination in the knee sprain, begins with a meticulous anamnestic interview, followed by inspection and palpation. The examination ends with a series of maneuvers to test the various potentially damaged structures of the knee.
*Results*. All the listed elements will allow us to establish the therapeutic management in the recent sprain of the knee and to differentiate the affected structures: sprain with the interest of the collateral ligaments or with the damage of the central pivot, represented by the cruciate ligaments.
*Conclusion*. Although with the advent of imaging investigations methods, which provide particularly important information and the diagnosis becomes much simplified, the stage of the physical examination of the patient in the knee sprain should not be omitted, it is an accessible and extremely useful tool in the orientation toward diagnosis.

***Key words****: sprained knee,* physical examination*, knee movements.*

**Rezumat**

*Introducere*. Pacienţii cu leziuni la nivelul genunchilor pot fi consultaţi într-o primă etapă de specialişti , precum medicul sportiv, iar într-o a doua etapă, în funcţie de gravitatea leziunii şi de orientarea terapeutică, poate fi necesar consultul de către chirurgului ortoped şi/sau specialistului de rebilitare medicală.
*Obiectiv*. Deosebit de important în patologia traumatică a genunchiului este examenul clinic. Acesta trebuie să fie riguros şi sistematic deoarece, pe baza lui, se poate stabili un diagnostic corect, care să aprecieze şi gradul de severitate al leziunilor. Numai astfel se poate lua decizia terapeutică optimă pentru a stabili un diagnostic iniţial precis şi pentru a evalua severitatea entorsei, în funcţie de care se decide tratamentul medical sau ortopedico-chirurgical.
*Metode*. Examinarea clinică completă şi precisă în entorsa genunchiului începe cu un interviu anamnestic meticulos, urmat de inspecţie şi palpare. Examinarea se încheie cu o serie de manevre pentru a testa diferitele structuri potenţial lezate ale genunchiului.
*Rezultate*. Toate elementele enumerate ne vor permite să stabilim managementul terapeutic în entorsa recentă de genunchi şi să diferenţiem structurile afectate: entorsă cu interesarea ligamentelor colaterale sau cu afectarea pivotului central, reprezentat de ligamentele încrucişate.
*Concluzii*. Deşi odată cu apariţia metodelor de investigaţie imagistice, care oferă informaţii deosebit de importante şi diagnosticul devine mult simplificat, etapa examenului clinic al pacientului nu trebuie omisă, fiind un instrument accesibil şi extrem de util în orientarea către diagnostic.

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***Cuvinte cheie**: entorsa genunchiului, examen clinic, mişcări ale genunchiului*

## Introduction

Knee sprain is a pathological entity defined by streching or tearing one or more ligaments of the knee (fig. 1), thereby affecting the stability of this joint. There are differences between the sprains that affect the central pivot and those that affect only peripheral structures, as their recovery is different (Lauersen, Bertelsen & Andersen, 2014), It is important to establish an accurate diagnosis, as well as the type of structure that has been damaged, in order to apply the appropriate treatment and optimize recovery without the installation of sequelae (Dwyer & Whelan, 2012).

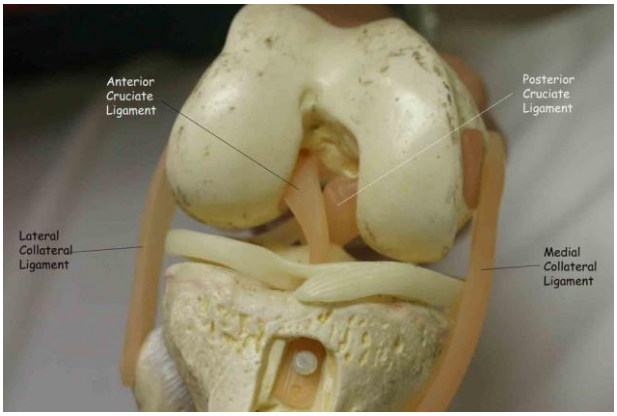


Fig. 1. The four major knee ligaments (Vertullo, 2015)

Common causes of knee sprains:

- ✓ The ACL may often be injured while running or during a contact sport, as a result of a sudden twist or landing after a jump.
- ✓ PCL injuries can appear during a sport (after a kick in the knee while it is bent or a hard fall on the knee) or during a car accident.
- ✓ An MCL sprain it is provoked when a force is applied to the outside of the knee, pushing the knee inward.
- ✓ The LCL sprain is possible after a blow to the inside of the lower limb, less common than the other types of sprains.

Knee sprain can be caused by extrinsic, non-modifiable factors such as terrain, footwear, weather, type of
sport and sports context (major or moderate injuries often occur at the end of the workout). There are extrinsic factors that can be modified, such as sports regulations, training in use of equipment and training of coaches (Andrews, Marrelson & Wilk, 2012).

Intrinsic, unchangeable and modifiable factors also come into play. First, there is anatomy that defines certain unfavorable parameters, such as joint laxity, recurvatum, the Q angle that measures the laxity of the patellar ligament and quadriceps ligament. Genetic predispositions and, of course an old lesion might be negative factors. Also the structure of ACL (size, force and insertion), as well as of the other ligaments, which may vary.

Imaging techniques evolve rapidly and prove their effectiveness in making an easy, correct and timely diagnosis, but the initial stage of physical examination of the patient should not be omitted, frequently it can ensure the establishment of a correct diagnosis. These two stages must complement each other (Rossi et al., 2011).

## Methods

*Anamnesis, the first step in the clinical evaluation of a pacient.*

The interview consists of collecting data on the personal and heredo-collateral history of the pacient, the circumstances and the manner of the trauma, the associated symptoms and the evolution of the symptomatology until the specialist consultation (Yao & Haque 2012).

Following the anamnesis, the patient will be asked: age, sex, professional activity, sports activity, general pathological personal antecedents (comorbidities), and hereditary collateral antecedents, traumatic

history of the knee joint, the nature of the trauma and associated symptoms (valg, external force, trauma rotation during sport on the lower limb and feeling a crack at the knees), suport on the limb after trauma (evolving, standing, walking), pain (localization during and after trauma, at rest or when moving), swelling (how fast it occurs after injury), locked knee, instability or unsafe gait, movement of the patella during trauma, functional limitations in daily activities, work or sports. The personal data allows to establish a presumptive diagnosis of healthy or pathological knee, which will guide the physical examination and allow the explanation of old changes by applying specific tests (Jones, Covey & Sineath, 2015).

*The examination of the joint itself may be broken down into five distinct steps:*

*Step 1 Inspection*

Inspection is a prerequisite for systematic palpation. The observation of the patient's motor behavior in the waiting room (the position adopted in the sitting position) is continued with the observation of the way of transition to orthostatic position and movement in the examination room. Often we find the presence of an antalgic attitude, avoiding support and sometimes even without it.

Look carefully at the joint, paying particular attention to the following points;

Is there swelling? If so, is the swelling *diffuse* or *localized*? If the swelling is diffuse, does it seem confined to the joint or does it extend beyond the joint? *Swelling confined to the joint* suggests distension of the joint with excess synovial fluid (effusion), blood (hemarthrosis), or pus (pyarthrosis). *Swelling extending beyond the confines of the joint* may occur with major infections in a limb, tumors, and problems of lymphatic and venous drainage.

If there is a localized swelling, note its position in relation to the underlying anatomical structures, as this may give a clue to it is possible nature or identity.

Is there bruising? This might suggest trauma, with a point of impact or gravitational or other spread.

Is there any other discoloration, or edema? This might occur as a localized response to trauma or infection.

Is there muscle wasting? This usually occurs as a result of disuse from pain or incapacity, or from denervation of the muscles affected.

Is there any alteration in shape or posture, or is there evidence of shortening? There are many possible causes for each of these abnormalities (including congenital abnormalities, past trauma, disturbances of bone mineralization and destructive joint disease); their presence should be noted, and explored in further detail during the course of the examination.

After the first observation, the analytical examination of the knees in al planes follows. Note that the inspection will be carried out in comparison.

- Examination of the patient in front:
  - the presence of a symmetrical or asymmetric varus or valgus;
  - knee stiffness -the lower pole normally aligned to the joint space;
  - evaluation of periarticular muscles: important atrophy or contraction;
  - swelling or hematoma.
- Examination of the patient in the profile:
  - the presence of a flexum or recurvatum.
- Examination of the patient from the back:
  - evaluation of tendino-muscular relief of ischiogambiers and gastrocnemians;
  - a swelling of the popliteal fossa can be established that directs the diagnosis to the presence of a synovial cyst.
- Place the patient in a seated position with the knees flexed at $90^0$, with the legs outside the supporting surface and investigate the signs leading to the diagnosis of knee sprain:
  - patellar asymmetry;
  - disappearance of bone reliefs that signify the presence of a swelling;
  - the presence of a hematoma;
  - the presence of possible skin lesions and changes in skin coloration.

*Step 2 Palpation*

This involves using the touch various structures around the knee to feel for to assess if a structure is painful to touch. Some of the points which you should note include the following.

Is the joint warm? If so, note whether the temperature increase is diffuse or localized, always bearing in mind the false impression which may be caused by the effects of local

bandaging. A *diffuse* increase in heat occurs when a substantial tissue mass is involved, and is seen most commonly in joints involved in pyogenic and non-pyogenic inflammatory processes, and anastomotic dilatation proximal to an arterial block. Away from the joints themselves, infection and tumor should be kept in mind. A localized increase in temperature generally pinpoints an inflammatory process in the underlying anatomical structure. Asymmetrical coldness of a limb commonly occurs where the limb circulation is impaired, e.g. from atherosclerosis.

Is there tenderness? If so, note if it is diffuse or localized. Where tenderness is diffuse, the cause is likely to be the same as for an increase in local heat. When there is localized tenderness, the site of maximal tenderness should be assiduously sought, as this may clearly identify the underlying anatomical structure which is involved.

Palpation should always be done bilaterally and in a comparative way. It should start in a painless area to put the patient safely and allow optimal relaxation. Palpation should be performed from two position: with the patient seated and with the patient in dorsal decubitus.

Before palpation the examiner may detect an increase in local temperature that is a sign of inflammation.

Palpation of bone and cartilage relief should be performed first with the patient seated. This position makes it possible to detect the affected structures by inducing pain (provoked pain). It is therefore necessary to examine:

- tibial tuberosity;
- medial and lateral tibial epiphyses superimposed by tibial glands;
- the head of the fibula;
- the anterior surface of the patella;
- femoral warts;
- internal and external articular lines locating pain that will lead to meniscal involvement.

In the dorsal decubitus position, the patella can be easily mobilized, both from top to bottom and from inside to outside. Palpation can cause pain (cartilage patellar syndrome).

The presence of swelling of the knee joint directs the examiner to an injury of one or more intraarticular structures. In addition, it requires a repeat examination after resorption because a swollen knee will only allow a partial or zonal physical examination. The examiner applies various tests to detect the swelling, and the test will be bilateral, addressing both the affected knee and the healthy knee to be able to compare the results (symmetric and comparative assessment).

• distribution of fluid accumulation:

The patient is positioned in the dorsal decubitus. With one hand, the examiner surrounds the patella laterally with his thumb on one side and his fingers on the other, and with the other hand compresses the overlapping fossa. If the finger or fingers are then pushed back sideways, the test is positive. This test is very sensitive and can detect low volume joint fluid.

• patellar shock or ice cube sign:

This test is carried out as follows: With one hand, the examiner presses on the supersatellite Bursa to empty it, and on the other hand, makes a vertical pressure with one finger in the center of the patella. Fluid accumulation is highlighted if the patella rests on the femur and then returns to the starting position, as if it were thrown on the femur, when the examiner releases the pressure.

Several ligament structures should be palpated in the seated position for an induced pain or depression that may be caused by injury or rupture of a ligament. Sometimes painful palpation of ligaments can make it difficult to continue the examination and may affect the relevance of this exam (Andrews, Marrelson & Wilk, 2012).

- the patellar ligament is palpated from the lower part of the patella, at the level of the anterior tuberosity of the tibia, from left to right; normally, this anatomical formation must be tense and homogeneous;
- the internal collateral ligament is palpated from the internal femoral condyle to the internal tibial plateau;
- the external collateral ligament is palpated from the fibular head to the external femoral condyle.

The most favorable position for palpation is when the patient's ankle is positioned on the opposite knee.

As for tendon structures, palpation includes the inserts of the tailoring muscles, gracilis and semitendinos.

The quadriceps muscle should be palpated in the dorsal decubitus position. The presence of a global or local amyotrophy will be investigated. The muscle volume will be measured compared to a metric strip, positioned about 10 cm above the articular space.

The popliteal fossa is also palpated in the dorsal decubitus position; the hands of the examiner are symmetrically positioned on either side of the knee, and the fingers II–V are inserted into the popliteal fossa, investigate its symmetry and can detect the presence of a synovial cyst. With the positioning of the knee in slight flexion, the popliteal artery can be palpated.

Articular amplitude. The active and then passive amplitudes must be assessed first.

The active flexion is 140° and the active extension is 0°. The external and internal rotations are 10° each (knee rated in flexion).

Passive joint amplitudes are normally higher than active ones, as passive mobilization allows the relaxation of antagonistic muscles. The flexion is 160° and the extension is 5° to 10°. External and internal rotations reach amplitudes from 15° to 20° each.

A decrease in these amplitudes can be seen in the presence of joint swelling, acute joint blockage or pain.

Pain triggered by the active extension of the knee can be observed in the trauma of the patellar tendon.

*Step 3 Examination of movements*

An assessment of how is made the walk and to notice small changes in the motion around the knee during different phases of walking. Most, but not all, orthopedic conditions are associated with some sensations (crepitus) when the joint is moved, and this may be detected by palpation or auscultation. Clicks coming from the joint on movement may be produced through soft tissues moving over bony prominences (generally of little importance), from soft tissues within the joint (e.g. displaced menisci), or from disturbances in bony contours (e.g. from irregularities in a joint surface following a fracture involving the joint).

A measurement of strength can help determine if muscular weakness or imbalance is causing your knee pain. The strength of muscle contraction (and hence the strength of each joint movement) must be carefully assessed, and especially if found reduced, recorded on the Medical Research Council (MRC) scale:

M 0- No active contraction can be detected.

M l- A flicker of muscle contraction can be seen or found by palpation over the muscle, but the activity is insufficient to cause any joint movement.

M 2- Contraction is very weak, but can just produce movement so long as the weight of the part can be countered by careful positioning of the limb.

M 3- Contraction is still very weak, but can produce movement against gravitational resistance (e.g. the quadriceps being able to extend the knee with the patient in a sitting position).

M 4- Strength is not full, but can produce movement against gravity and added resistance.

M 5- Normal power is present.

Muscle strength may be impaired by pain or wasting from disuse, disease or denervation. Finally, attention should be paid to any impairment of overall function in the affected limb as a result of disturbance of movement or muscle power. In the case of the legs, this implies an assessment of the gait. Many tests are available to detect disturbance of separate aspects of the knee function.

Range of Motion Measurements, is refers to how far the knee is bending or straightening.

*Step 4 Conduction of special tests*

Special tests are specific maneuvers performed around the knee to help determine which structure may be at fault and may be causing the problem. For most joints there are a number of specific tests developed especially to test some particular aspect of that joint's function. These include tests for the integrity of certain joint ligaments, and for the examination of structures associated with the joint. Of particular importance is an appropriate neurological examination.

*Step 5 Examination of radiographs*

Examination of x-rays that could evaluate, bones, ligament attachments, joint edges, joint space, and cortical and cancerous bone elements.

*Clinical maneuvers*

At this stage of the examination it is possible to detect a bone lesion, in which case the ligaments and meniscus are not tested; the patient should benefit from additional examinations (DePhillipo et al., 2020).

If the presumption of fracture is ruled out, the examination should be continued for ligament or

meniscus injury. Clinical maneuvers are performed under conditions of optimal relaxation of the muscles that act on the knee joint (Fanelli, 2013). Relaxation is induced by the correct positioning of the patient. Maneuvers must always be painless. If the patient complains of pain, the clinical maneuvers lose their objective character, therefore they can be resumed only after the administration of an analgesic.

*Ligament testing*

*1) Anterior cruciate ligament*

In knee injuries, damage to the anterior cruciate ligament is much more common than that of the posterior cruciate ligament (Silva, Ribeiro & Oliveira, 2012).

*The Lachman test* is named after orthopedic surgeon John Lachman of Temple Philadelphia School of Medicine and is the one who described it.

The Lachman test is a clinical test used to diagnose cruciate ligament injuries. The patient positioned in supine position, the knee flexed at 20-30 °, one hand is applied in the popliteal space, and the other on the patient's thigh (immediately above the knee), the examiner's thumb rests on the tibial tuberosity.

The tibia is moved anteriorly to the femur to assess the degree of movement in its anterior plane. Slight displacement of more than 2 mm suggests a possible ligament injury (weak or torn).

*Pivot test.* The patient is positioned in supine position, with the knee extended. The examiner grabs the patient's leg with one hand and lifts it from the treatment table.

Initially, perform a valgus movement, passive knee flexion at 70 ° and internal rotation. In the second stage, progressively expand the knee, maintaining internal rotation and valgus. In the flexion movement from an amplitude of 30 ° to 40°, an interruption of movement can be observed, if the anterior cruciate ligament is broken.

This corresponds to the anterior subluxation of the external tibial plateau on the external femoral condyle. Compared to Lachman's test, this test is less accurate, but more specific (97%). The positivity of the test confirms the diagnosis.

*Previous drawer test.* The patient is positioned in supine position with the knee bent at 90 °. The examiner locks the patient's leg and grabs the popliteal space with both hands, the fingers are placed along the joint line on each side of the patellar tendon. Then exert anterior traction on the leg. If the anterior cruciate ligament is broken, the translation will increase relative to the healthy knee, and the stop will be slow and progressive.

This test evaluates the laxity and integrity of the anterior cruciate ligament. It can help diagnose sprains and ruptures.

*2) Posterior cruciate ligament*

*Godfrey's sign.* The patient lies in supine position. The examiner grabs the two ankles and lifts them to obtain a flexion at the hip and knee with an amplitude of 90° each. From this position he visualizes the anterior tuberosity of the tibia, which normally protrudes.

*Rear drawer test.* The patient lies in supine position, knee bent at 90°. The examiner locks the patient's leg and grabs the upper end of the tibia with both hands, and the fingers are applied to the anterior tuberosity of the tibia. Then apply pressure to the leg and push it backwards. If the posterior cruciate ligament is broken, the translation will have a higher value compared to the healthy knee, and the stop will be slow and progressive.

*3) Collateral ligaments*

In knee injuries, the internal collateral ligament is much more frequently injured than the external collateral ligament.

*Valgus and varus test.* The patient lies in supine position. To print the valgus, the examiner gently lifts the tense lower limb and grabs the heel with one hand and the side of the knee with the other hand. Then apply pressure to the heel and inward pressure to the lower thigh. This maneuver allows testing the internal plan.

To print the varus, the examiner pulls the heel with one hand and the middle part of the knee with the other. The pressures will be inverse in relation to the valgus, respectively inside the heel and outside on the lower thigh. The maneuver tests the external plan. The presence of pain evokes, above all, a lesion of the posterolateral (valgus) or posteroexternal (varus) point and expresses damage to the collateral ligament.

These tests are then performed with a slight flexion of the knee at 20 ° to relax the anterior cruciate ligament. The examiner then applies his fingers to the joint line (external for varus, internal for valgus)

to estimate the increase in interarticular space, respectively the laxity of the injured ligament.

*Meniscus testing*

*Mac Murray test.* The patient lies in supine position. The examiner lifts the patient's lower limbs and immobilizes the hip and knee. With one hand he grabs the heel and with the other hand, in a first phase, he catches the lateral part of the knee, then the medial part at the level of the interarticular space.

To test the internal meniscus, the examiner performs an externally rotating valgus extension, and to test the external meniscus, prints an internally rotating varus extension movement.

*The Apley test.* The patient is positioned in a prone position, the knee bent at 90 °. The examiner grabs the patient's foot with both hands and exerts a vertical pressure on the foot, which he associates with an internal rotation to test the external meniscus, respectively with an external rotation to test the internal meniscus. Triggering pain is suggestive of meniscus damage.

It is possible that the test will highlight the location of the lesion due to the angle of flexion that reproduces the painful symptoms. An extension pain evokes an injury to the anterior horn. Pain that migrates posteriorly during movement between amplitudes in the range of 45 ° -120 ° creates suspicion of damage to the junction of the middle and posterior segments, while pain at an amplitude between 90 and 130 ° suggests an injury to the posterior horn.

*Compression test.* The patient lies in supine position. The examiner applies one hand under the heel and one on the antero-inferior part of the thigh and performs hyperextension of the knee. The onset of pain highlights the damage to the meniscus.

**Results**

An alternative to the immediate use of imaging techniques to diagnose knee sprain is to conduct a skillful clinical examination, in this way we tried to present the main steps in order to develop a complete clinical examination. These tests have been used for many years and are widely recognized to have limited specificity and sensitivity, but a combination of a thorough clinical history and examination, followed by appropriate imaging, optimizes injury assessment and leads to optimal therapeutic management.

**Issues addressed**

We proposed this topic for research, because traumatology, in general, and implicitly of the knee, covers a wide area, offering a rich and different casuistry.

Our work begins with a reminder of the descriptive and functional anatomy of the knee joint, then with the clinical examination of the post-traumatic knee. Indeed, in traumatic pathology of the knee, the clinical examination remains essential.

**Conclusions**

The knee, is the largest superficial joint of the human body, is less covered and protected by soft parts, but at the same time is intensely stressed both in static and locomotion, which causes more pronounced wear of its anatomical elements, but also the predisposition to trauma.

The recommendations of specialists on the therapeutic approach to meniscus lesions and isolated lesions of the anterior cruciate ligament are convergent. However, the administration of treatment in case of a sprained knee may vary depending on the consulting physician and the patient's activity. The proposed therapeutic guidelines must be evaluated in relation to the data provided by the literature.

Meniscal lesions should be treated conservatively, if possible, to prevent intra-articular progression of the lesions.

After a clinical assessment of the lesions defining their level of gravity, the primary care specialist will be able to use these common elements to optimize his treatment by adapting it to his patient.

Clinical examination is important in the correct application of treatment in the sprain of the knee. This allows, on the one hand, the elimination of the worst differential diagnoses, namely fractures, and, on the other hand, the assessment of the severity of the lesion. Primary care physicians (emergency physicians, general practitioners, and sports trauma physicians) have an important role to play in the initial therapeutic orientation. Their training in clinical examination of the knee should therefore be strengthened.

The therapeutic management of the recent knee sprain must therefore be done on a case-by-case basis after clear and honest information from the patient. It is therefore fundamental that the practitioner individualizes his care by integrating the patient in his complex and global dimension.

Complementary examinations are available to help the clinician establish a correct diagnosis of major and associated lesions. This is the case of ultrasound capable of assessing isolated lesions of the collateral ligaments, while MRI is the gold standard for exploring the central pivot and meniscus.

In this context, the preoccupations of the specialists are directed towards the knowledge of the evolution of the therapy applied in the post-traumatic pathology and the synthesis of the therapeutic approach, both from the perspective of orthopedic surgery, rheumatology and medical recovery.

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