№ЛД-16 ИН

Federal state budgetary educational institution higher education
«NORTH OSSETIAN STATE MEDICAL ACADEMY»
Ministry of health of the Russian Federation

Department of Traumatology and Orthopedics

THE KNEE JOINT

Educational and methodical manual for students

Traumatology and orthopedics

Vladikavkaz 2020

Approved at the meeting
of the Department of traumatology
and orthopedics on August
27, 2020, Protocol No. 1
«APPROVED»

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The purpose of the lesson: to teach students the basic techniques of diagnosis and care for patients with injuries and diseases of the knee joint.

Questions to repeat:

1. Clinical anatomy of the knee joint.
2. Biomechanics of the knee joint.
3. Methods of examination of patients with pathology and injuries of the knee joint.

After the practical lesson, the student should KNOW:

1. The mechanisms of injury and the resulting damage to the knee joint.
2. Classification of knee joint injuries.
3. Clinical symptoms of ligament and meniscus injuries of the knee joint,
4. X-ray semiotics of knee joint injuries.
5. Methods of additional diagnosis of these injuries: puncture of the knee joint, artificial contrast, arthroscopy, ultrasound, computed tomography.
6. Principles of first aid for various injuries of the knee joint.
7. Principles of treatment of various injuries of the knee joint.

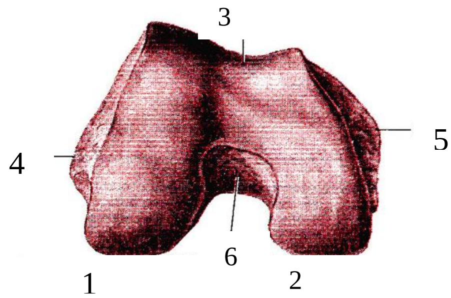
After the practical lesson, the student should BE ABLE to:

1. Find out complaints and collect anamnesis in patients with knee joint injury.
2. Examine the patient with various types of knee joint injuries and identify the clinical symptoms characteristic of each injury.
3. Correctly interpret the X-ray data.
4. Diagnose various injuries of the knee joint.
5. Provide first aid to a patient with knee joint injuries.

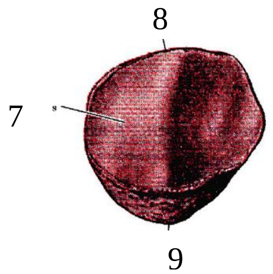
ANATOMY OF THE KNEE JOINT

The knee joint is a combination of the block joint with the rotator joint and belongs to the rotator-block joint, trochoginglymus.

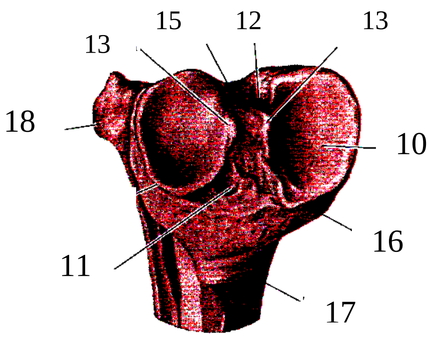
18-head of the fibulaThree bones are involved in the formation of the knee joint, articulatio genus: the lower end of the femur, the upper end of the tibia, and the patella.



A) *femur*



Б) *patella*, right



B) Tibia, tibia, and fibula, fibula, right, proximal ends; above and somewhat anteriorly

A-FEMORAL CONDYLES:

1-medial condyle;

2-lateral condyle;

3 – facies patellaris;

4-medial condyle;

5-lateral epicondyle;

6-the interstitial fossa.

B-PATELLA:

7 – facies articularis;

8-patellar base;

9-the top of the patella.

B-CONDYLES OF THE TIBIA:

10 – facies articulares superiores;

11-anterior interstitial fossa;

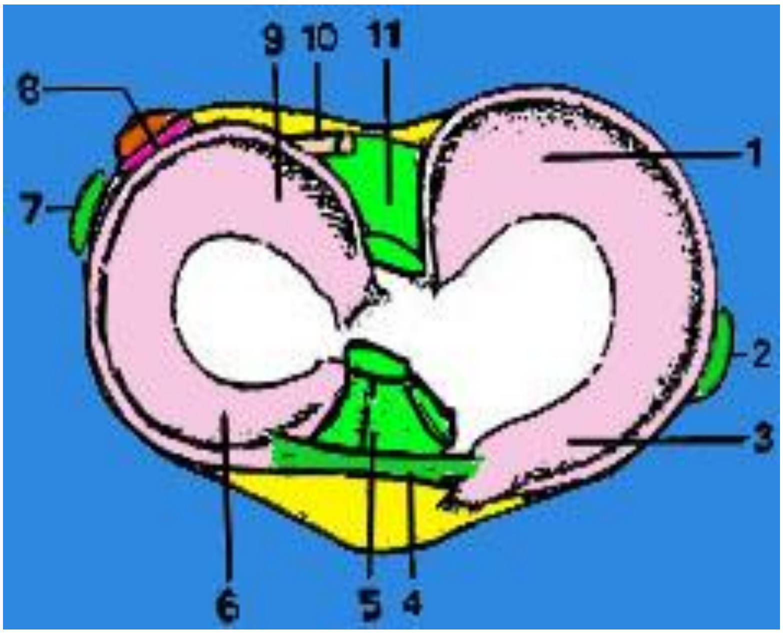
12-posterior interstitial fossa;

13-lateral interstitial tubercle;

14-medial interstitial tubercle;

Fig. 1. Bones involved in the formation of the knee joint.

The articular surface of the femoral condyles is ellipsoid in shape (Fig.1): the curvature of the medial condyle (1) is greater than that of the lateral condyle (2). On the anterior surface of the bone, between the condyles, is the patellar surface, facies patellaris (3). A small vertical groove divides this surface into the medial, smaller, and lateral, larger, areas that articulate with the corresponding articular surfaces located on the posterior articular surface of the patella, facies patellaris (3).articularis (7). The upper articular surfaces of the tibial condyles, facies articulares superiores (10), are slightly concave and do not correspond to the curvature of the articular surfaces of the femoral condyles. This discrepancy is somewhat leveled by the interstitial cartilages located between the condyles of the femur and tibia, the medial and lateral menisci, menisci medialis et laleralis.



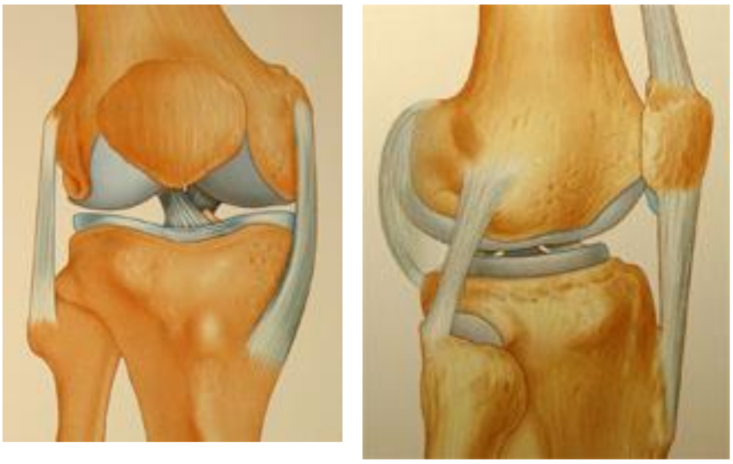
1-medial meniscus;
2-internal lateral ligament;
3-anterior horn of the inner meniscus;
4-transverse ligament;
5-anterior cruciate ligament;
6-lateral meniscus;
7-external lateral ligament;
8-Hiatus poplitea;
9-posterior horn of the external meniscus;
10-meniscopal ligament;
11-posterior cruciate ligament.

Fig. 2. Menisci of the knee joint.

Menisci are fibrous-cartilaginous formations of a semilunar shape. Their outer edge is thickened and fuses with the joint capsule, the inner, free, edge is pointed and faces the joint cavity. The upper surface of the meniscus is concave, the lower surface is flattened. The outer edge of the meniscus almost follows the configuration of the upper edge of the tibial condyles, so the lateral meniscus resembles a part of the circle (6), and the medial (1) has a semilunar shape. The menisci are attached anteriorly and posteriorly to the eminentia intercondylaris of the tibia (see Figure 1). The anterior edges of both menisci are connected by the transverse ligament of the knee, lig. transversum genus (4).

The articular capsule, capsula articularis, is weakly stretched. In front, it fuses with the tendon of the quadriceps femoris, m. quadriceps femoris, and is attached to the patella along the edge of its articular surface. On the femur, the articular capsule is attached slightly above the articular cartilage in front, on the sides - almost at the cartilage, and behind-along its edge. On the tibia, the articular capsule is fixed along the edge of the articular surface of the bone. The inner surface of the joint capsule is lined *with a synovial membrane, which covers the ligaments located in the joint cavity and forms synovial villi, villi synoviales, and synovial folds, plicae synoviales. The most developed folds of the synovial membrane are: pterygoid folds, plicae alares, which run along the sides of the patella towards its apex and contain adipose tissue between their leaves; the sub-patellar synovial fold lying below the patella, plica synovialis infrapatellaris, is a continuation of the previous folds. It begins in the area of the top of the patella, goes into the knee joint cavity and attaches to the area of the anterior edge of the fossa intercondylaris femoris. The capsule of the knee joint forms a series of synovial eversions, eversiones synoviales, and synovial bags, bursae synoviales, lying along the course of the muscles and tendons, but not communicating with the joint cavity.*

Ligaments of the knee joint (Fig. 3) are divided into two groups: ligaments located outside the joint cavity, and ligaments lying in the joint cavity. On the lateral surfaces of the joint, there are the following lateral ligaments.



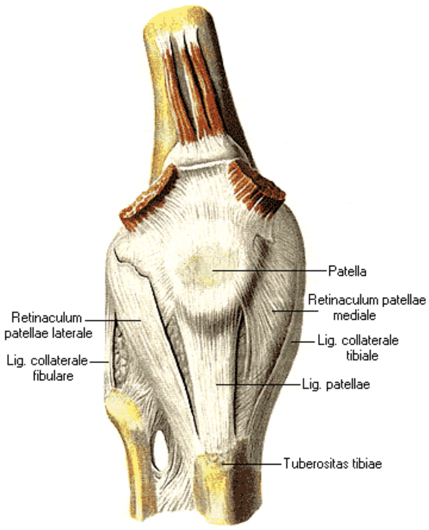
1-internal lateral ligament;
2-anterior cruciate ligament;
3-lateral meniscus;
4-external lateral ligament;
5-posterior cruciate ligament;
6-own patellar ligament.

Fig. 3. Ligaments of the knee joint.

The tibial collateral ligament, lig. collalerale tibiale, follows from the medial epicondyle of the femur downwards, fuses along the way with the joint capsule and the medial meniscus, reaching the upper part of the tibia.

The fibular collateral ligament, lig. collaterals fibulare, is already the previous one, starts from the lateral epicondyle of the femur, goes down, like the previous one, gives a number of its bundles to the articular capsule and attaches to the outer surface of the head of the fibula. The anterior parts of the joint capsule are strengthened by ligaments that are directly related to the tendon of the quadriceps femoris.

This muscle approaches the patella and is fixed at its base (Fig. 4). One part of the tendon bundles continues down and reaches the tuberositas tibiae (2), forming below the top of the patella the patellar ligament, lig. patellae (7). The other part of the bundles follows in a vertical direction along the sides of the patella and its ligaments, forming vertical ligaments – lateral and medial supporting the patella, retinaculum patellae laterale (5) et retinaculum patellae mediale (6). These ligaments are directed from the lateral parts of the patella to the corresponding condyles of the thigh. Under these ligaments are bundles of tendon fibers that have a horizontal direction, which go from the lateral parts of the patella to the epicondyles of the thigh.



1 – - patella;

2-tibial tuberosity;

3-lig. peroneal collaterals;

4 – lig.collalerale tibiale;

5 – retinaculum patellae laterale;

6 – retinaculum patellae mediale;

7-league kneecaps;

8-lig. popliteum obliquum

Рис. 4. Tendon-ligamentous apparatus of the knee joint.

The posterior parts of the articular capsule are strengthened by the oblique popliteal ligament, lig. popliteum obliquum (8). The ligament follows from the medial condyle of the tibia to the lateral condyle of the femur and along the way part of its bundles is woven into the articular capsule.

The following ligaments are located inside the knee joint cavity (Fig. 2, 3):

1. Anterior cruciate ligament, lig. cruciatum anterius. it starts from the inner surface of the lateral condyle of the femur, follows forward and medially, attaching to the area intercondylaris anterior tibiae.

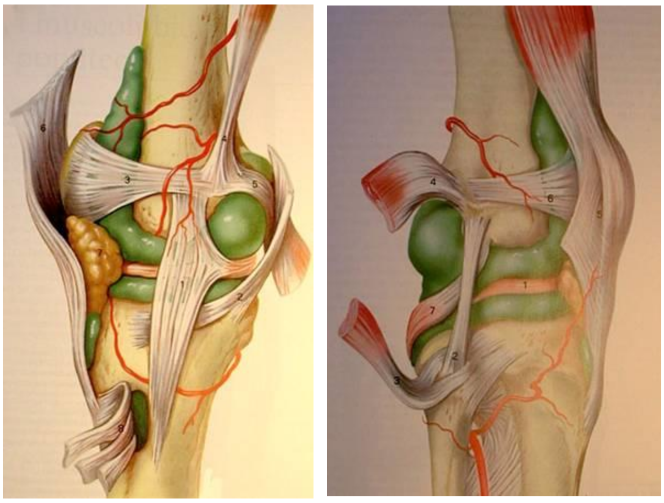
2. The posterior cruciate ligament, lig. cruciatum posterius, begins on the inner surface of the medial condyle of the femur, follows backward and medially, and, crossing with the anterior cruciate ligament, attaches to the area intercondylaris posterior tibiae.

3. The transverse ligament of the knee, lig. transversum genus, connects the anterior surface of both menisci.

4. Anterior menisco-femoral ligament, lig. meniscofemorale anterius, starts from the anterior part of the medial meniscus, goes up and laterally to the medial surface of the lateral condyle of the femur.

5. Posterior menisco-femoral ligament, lig. meniscofemorale posterius, follows from the posterior margin of the lateral meniscus upward and medially to the inner surface of the medial condyle of the femur.

The knee joint is surrounded by several synovial bags bursae synoviales located near it (Fig. 5), connected to the articular cavity:



5. Synovial bags of the knee joint.

1. Bursa suprapatellaris is located between the m. quadriceps femoris and the femur (in 12%, it may not be associated with the articular cavity).

2. Bursa m. poplitei is located between m. popliteus on one side and meniscus fibularis on the other.

3. Bursa capitistibialis m. gastrocnemii.

4. Bursa m. semimembranacei fibularis. These two bags can be combined into one, forming bursa gastrocnemiosemimembranacea.

There are also several mucosal bags in the area of the knee joint, but they are not connected to the joint cavity:

5. Bursa praepatellaris subcutanea.

6. Bursa praepatellaris subfascialis.

7. Bursa praepatellaris subaponeurotica.

8. Bursa infrapatellaris subcutanea.

9. Bursa infrapatellaris profunda (between lig. patellae proprium and tibia).

Almost never all of these bags are found at the same time, but only some of them in different combinations.

BIOMECHANICS OF THE KNEE JOINT

In the knee joint, there is flexion (flexio) and extension (extensio) of the lower leg, as well as external and internal rotation of the lower leg relative to the hip. The main flexors are the muscles (Fig. 6) that limit the popliteal fossa from the sides (semi-webbed and semi-tendonous on the medial side and biceps on the lateral side). They act most effectively when the hip joint is bent. Additional flexors are the graceful, sartorial and medial part of the calf (on the inside), as well as the popliteal and lateral part of the calf (on the outside). When the knee is in a bent state ("unlocked"), the tibia can perform rotational movements on the femur, 40 degrees out and 30 degrees in: the lateral group of the popliteal fossa muscles and the muscle straining the broad fascia of the thigh rotate the tibia outwards, and the medial group and popliteal muscle-inwards

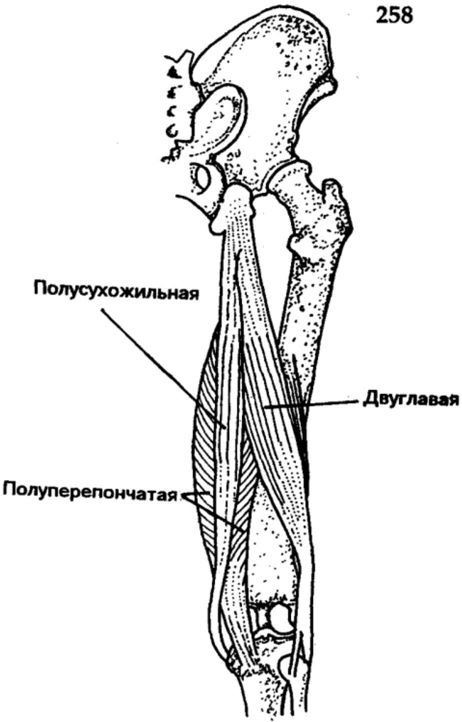


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Fig. 6. Basic knee flexors.

The medial, lateral, and intermediate broad muscles begin at the femur (Fig. 7) and are a powerful extensor device that stabilizes the knee, especially under load. The medial broad muscle is located most distally and contracts as much as possible at the last 10 degrees of extension, taking part in blocking the edial rotation of the femur on the tibia. The rectus femoris (the fourth component of the quadriceps) originates on the anterior superior spine of the ilium and thus acts on two joints (hip and knee). In the straight position of the lower limb, the lower leg is a straight extension of the thigh, forming an angle of about 180°with it. Ligg. collateralia is very tightly stretched, which makes it impossible to make movements to the side. The cruciate ligaments and the posterior surface of the articular bag are stretched almost to the last limit. From this initial position, an active flexion of up to 130° is possible, after which a passive flexion of up to 150-160° can be obtained (by external pressure on the lower leg or thigh). At the last degree of flexion both cruciate ligaments are twisted and elongated ad maximum, and the patella is displaced downward from the facies patellaris along the articular planes of the condyli femoris. In this position, the contours of the knee are rounded. The greatest degree of rotation of the lower leg can be obtained

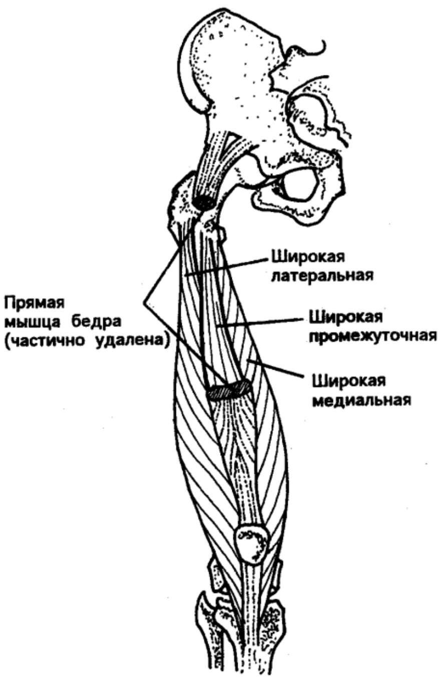


Рис. 7.

when bending at an angle of about 70°. The internal rotation is possible only about 10°, it is prevented by the torsion of the cruciate ligaments, and the external rotation is about 40°, because it is prevented by the lig. collaterale tibiale.

EXAMINATION OF THE NORMAL KNEE JOINT

Inspection. The superficial position of the knee joint facilitates the examination and allows you to feel the extensive parts of the thigh and lower leg involved in the formation of the joint. Examination of the knee joint determines the axis of the lower limb. Normally, the axis of the lower limb extends from the center of rotation of the femoral head through the middle of the patella to the middle of the ankle joint (Fig. 8, a).

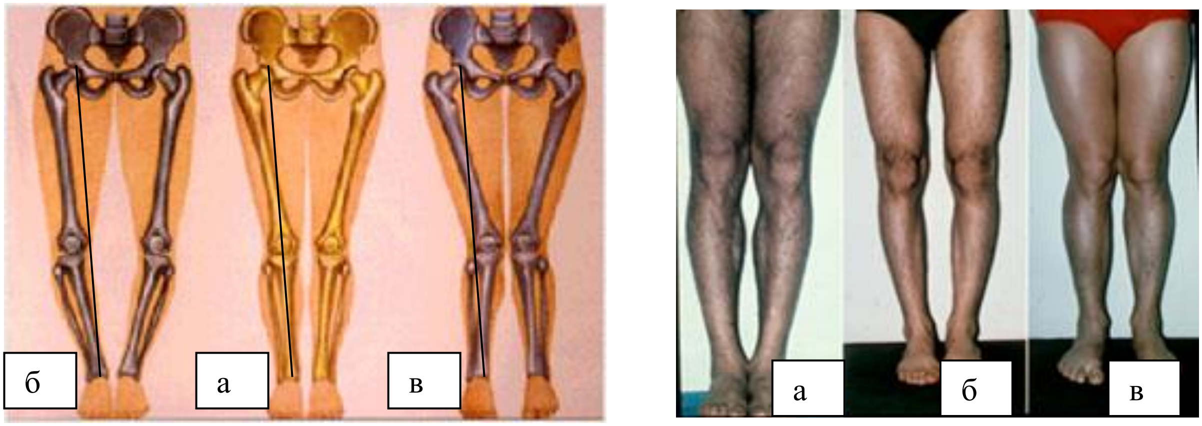


Fig. 8. The shape of the knee joints.

The direction of the hip axis to the shin axis is subject to significant individual, age, and sex variations. In childhood, as a physiological phenomenon, the curvature of the knee joints is convex to the outside: the inner surfaces of the knees in a small child do not touch (genu varum) (Fig. 8, b). This shape of the legs, regardless of gender, persists on average until the 3rd-4th year of life. From this time on, the physiological attitude of genu varum begins to gradually disappear, passing into genu rectum and then into genu valgum (Fig. In males, there is often no external deviation of the lower leg; the axis of the lower leg in men often coincides with the axis of the hip (genu rectum). In girls, the evolution of the hip and lower leg position is much faster. The physiological attitude of genu valgum in women is much more pronounced than in men. In old age, regardless of gender, you have to observe genu varum more often.

A detailed examination of the knee joint area shows that its relief is formed by bone and muscle elevations and, to a lesser extent, ligaments. When the knee is bent, the kneecap rises above the surface of the knee joint. On the sides, outside and inside of it, two depressions are noticeable, bounded proximally by the edges of T. T. vastus medialis et lateralis. Outside and inside the knee, the medial and lateral condyles of the femur protrude, limiting the above-mentioned depressions (parapatellar fossa). Their distal border is marked by prominent condyles of the tibia. Parapatellar pits are of great practical importance in the study, since they correspond to the place where the bag of the knee joint is located directly under the skin. When viewed in profile, the front contour of the thigh above the kneecap under normal conditions forms a depression. This department is also of great practical importance in clinical terms, since the upper inversion of the knee joint bag is located here. The popliteal fossa is bounded on the outside by the biceps tendon, on the inside by the semipereminous muscle.

When examining the leg from behind with the maximum bent knee joint, the lower leg, despite the presence in the extension position of its physiological deviation to the outside (genu valgum), lies on the hip; the axis of the lower leg with the bent knee joint coincides with the axis of the hip. From this it can be concluded that the physiological deviation of the axes of the thigh and lower leg with the bent knee is determined by the shape of the anterior sections of the femoral condyles.

Feeling. Feeling the area of the knee joint makes it possible to determine the following parts of the bone base of the knee: the patella (patella) — in front of it throughout; the condyles of the thigh — in front, where they are not covered by the patella, and from the sides; the condyles of the tibia; the tuberosity of the tibia (tuberositas tibiae) where the patella's own ligament is attached (lig. patellae proprium); the articular gap and the head of the small the tibia. The tendons of the muscles and the patellar ligament are easily palpated from the soft tissues. The joint bag is not normally palpable.

The range of motion. From the extended leg position (180°), the active knee flexion is performed within 128°. Passively, this type of movement in the knee joint can be increased by 30° (Mole). This extreme flexion is obtained during squatting or when forcibly pressing the heel to the buttock. From the unbent position of the knee joint, it is passively possible to get a re-extension within 12°. The total range of passive movements in the knee joint is, according to Molya, 170°. When the knee is bent, another type of movement appears — rotation outward and inward of the condyles of the tibia in relation to the fixed articular end of the thigh, or the corresponding movement of the thigh with a fixed lower leg. When the knee is bent, this movement disappears. When the knee is bent at an angle of 45°, the rotation of the lower leg is possible within 40°, when bending at a right angle-50°, when bending up to 75°, the rotation amplitude reaches 60° (Mole).

The scope of movements is checked by the following techniques. In the supine position of the patient, when the popliteal surface comes into contact with the plane of the table, the knee joint can be passively re—bent so that the heel rises above the surface of the table by 5-10 cm.

Bending at the extreme limit allows the heel to touch the buttock.

There are no lateral movements (withdrawal and reduction) in the bent knee. With a bent knee and relaxed lateral ligaments, lateral movements are possible to a small extent. Rotation is similar to lateral movements. The antero-posterior displacement of the lower leg in relation to the thigh with the integrity of the cruciate ligaments is absent both when the knee is unbent and bent.

When bending and extending the knee, the articular end of the lower leg performs two movements in relation to the condyles of the thigh: rotational and planar; the total result of such movements can be represented by comparing them with the movement of a rolling wheel that is not completely braked.

According to the neutral 0-passing method, the amplitude of normal movements in the knee joint is equal to: ext./flec.-5°/0/140°/.

SEMIOTICS OF KNEE JOINT INJURIES

Complaints.

Pain that occurs in the knee is mainly felt on the anterior surface, often with localization in the affected area (for example, in front of the femoral-patellar joint, or in front and medially, or in front and laterally with the defeat, respectively, of the medial or lateral parts of the joint). The pain rarely radiates far from the knee joint. Significant radiation down the lower leg usually means severe subchondral bone collapse or intraosseous hypertension. The innervation of the anterior surface of the knee is carried out by the roots L2/3 (Fig. 9), so the pain can be reflected in this area when the L3 root or hip joint is affected.

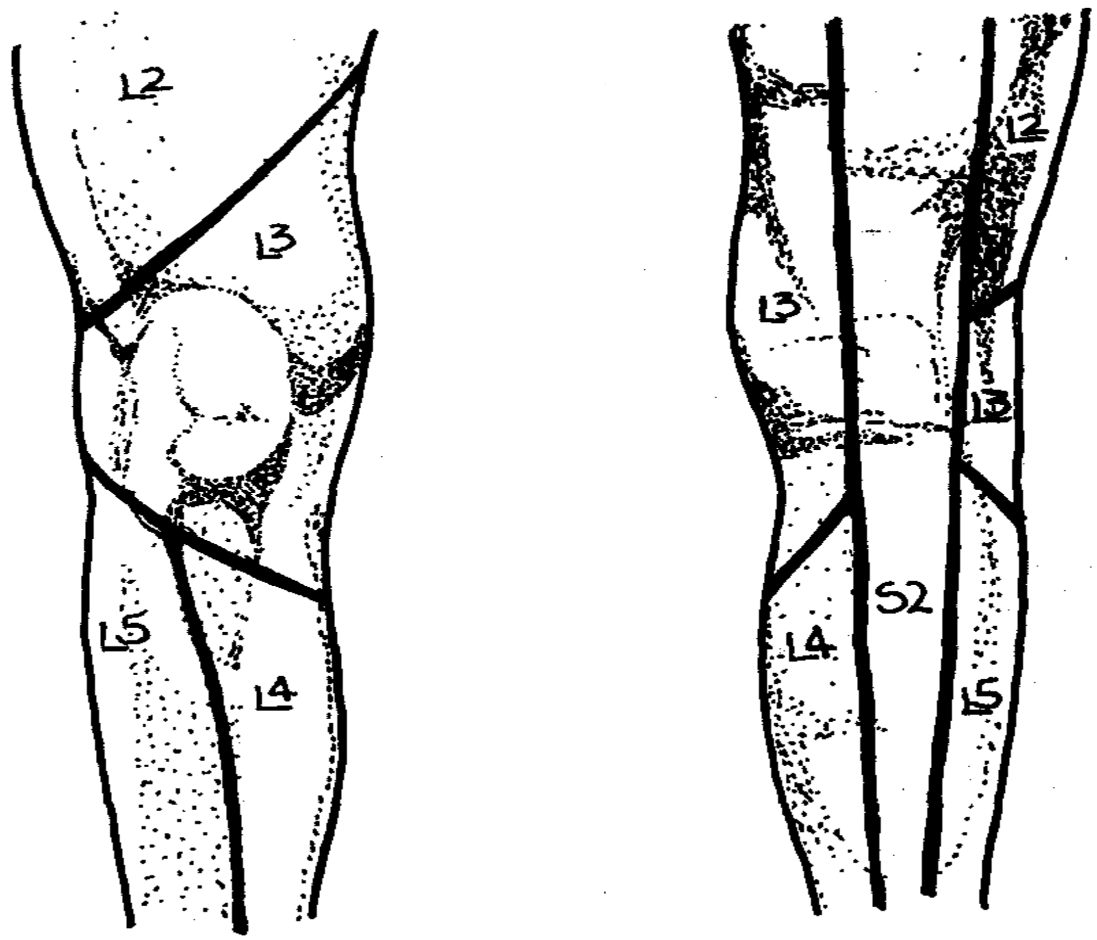


Рис. 9. Иннервация области коленного сустава.

Reflected pain often differs from pain that occurs directly in the knee joint in that it is 1) less clearly localized, 2) often accompanied by pain above the knee, and 3) aggravated by various factors. For example, pain from the root of the L3 often begins in the buttocks, subsequently descending along the front surface of the thigh to the knee. It doesn't always get worse when you walk, but it can get worse when you cough. The posterior surface of the knee is innervated by S1 / 2 (Fig. 9). Pain only on the posterior surface of the knee joint suggests the presence of one of the complications of arthropathy (for example, popliteal cyst, subluxation of the lower leg back) or damage to the root S2. Other local causes include enteropathy of the popliteal fossa and calf muscles, lymphadenopathy, and popliteal artery aneurysm.

"Blocking" of the joint is the inability to straighten the knee, which occurs suddenly, usually transient and accompanied by pain. As a symptom, blockage is important from the point of view of mechanical damage, such as a meniscus tear, "articular mouse", or pinching of the synovial membrane fold (fold syndrome).

"Uncertainty" reflects a feeling of anxiety and a loss of confidence in the knee's ability to hold body weight. This mainly refers to a violation of the mechanism of interaction of the quadriceps/patella or instability of the joint due to damage to the stabilizing structures. Weakness of the quadriceps, especially v. medialis, or damage to the joint of the patella and femur disrupts the vertical sliding of the patella on the femur, which gives this unpleasant feeling of anxiety and fear. The instability of the ligaments also disrupts the biomechanics of the knee joint during exercise, so that the patient feels that "something is wrong".

Study

The patient should be examined both standing and while walking and lying on the couch. Usually, a comparison of the two sides of the body allows you to identify violations associated with a unilateral lesion.

Examination of the patient standing up. The patient should stand erect and be examined from the front, side, and back. The main signs observed are swelling and deformities in the popliteal fossa, as they are better visible when the patient is standing rather than lying down.

Deformations.

All fixed deformities, with the exception of flexor contracture, are better evaluated in the vertical position of the patient: varus and hallux valgus deformities can also be noted in the horizontal position of the patient on the couch, but they are significantly increased when the patient transfers the weight of the body to these joints. The main deformations (Fig. 10) are:

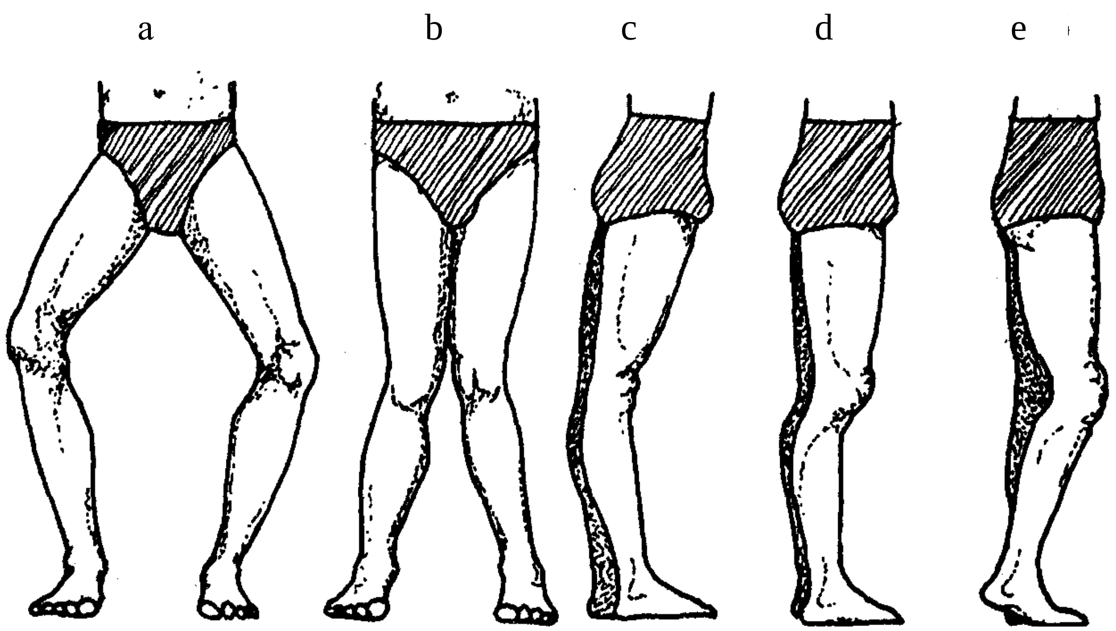


Fig. 10. Deformities of the knee joint: (a) varus; (b) hallux valgus; (c) genu recurvatum; (d) posterior tibial subluxation; (e) flexor contracture.

* genu varus (0-shaped legs). This usually reflects an isolated lesion of the medial joint (loss of cartilage + collapse of the subchondral bone) and is a characteristic deformity in uncomplicated osteoarthritis.

* Genu valgus (X-shaped legs). This is a typical deformity in arthropathies, accompanied by synovitis and knee damage in all three parts, which leads to loss of cartilage throughout the joint.

• Genu recurvatum. This deformity is particularly characteristic of generalized joint hypermobility.

* Posterior subluxation of the lower leg. This gives a step-like deformity and is especially characteristic of arthropathies that affect the growing knee joint.

* Fixed flexor contracture. The knee cannot fully straighten and is constantly bent at some angle. This deformity can complicate a large number of different arthropathies, but is especially characteristic of conditions accompanied by synovitis with an outcome in

fibrosis (for example, seronegative spondyloarthropathies). If the patient experiences pain during exertion and there is some kind of deformity, its manual correction (e.g., reduction of varus or valgus by pressure from the side) can help in determining whether the pain is predominantly mechanical in nature, and, accordingly, whether it can be eliminated by correcting the deformity.

Swelling

A popliteal cyst can cause significant swelling in the popliteal fossa when the patient is standing upright with his legs straight. An abnormally high patella (patella alta) can give a "camel's symptom" (Figure 11): when the patella is high (hump 1), the infrapatellar fat pad becomes more clearly contoured (hump 2). In the sitting position, when the knees are bent at an angle of 90 degrees, the patellae of such patients can move up and out (a kind of "frog eyes"). You may also notice varicose veins.

Research while walking.

Normal gait is characterized by:

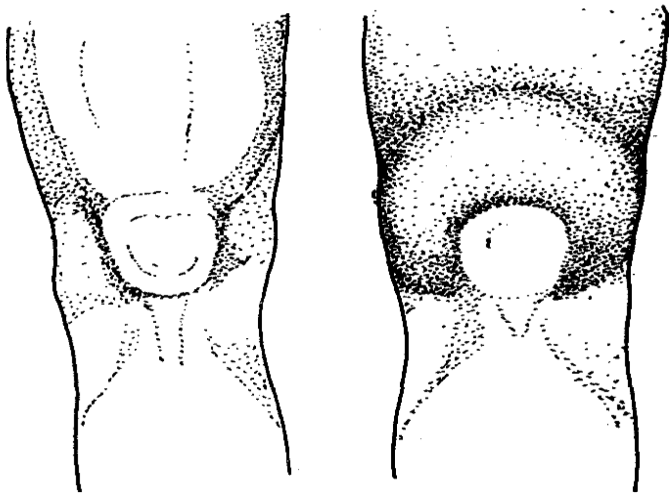
* a smooth movement of the hand associated with the movement of the opposite leg;
* smooth, symmetrical movement of the pelvis, turning forward with the front leg;
* flexion in the hip joint when setting the heel, extension in this joint when pushing with the toe;
* extension of the knee joint when setting the heel, flexion when transferring;
* normal setting of the heel, pronation of the foot in the middle position, lifting the heel before pushing off, back flexion of the ankle joint during transfer;
* the possibility of smooth rotation.

While watching the patient walk and turn, pay special attention to the antalgic gait, in which pain or deformity causes the patient to quickly transfer the weight of the body from the sick leg to the healthy one, lingering on the latter (often with concomitant asymmetry of the arm movement). The type of antalgic gait can help in determining the localization of the pathology of the musculoskeletal system. If the knee joint is affected, synovitis / deformity may prevent the joint from fully extending during the transfer phase and lead to careful heel positioning. If the knee is supported in a rigid state, the body rotates around the leg in a supporting phase and the leg is carried forward in a circular motion;

Examination of a patient lying on a couch

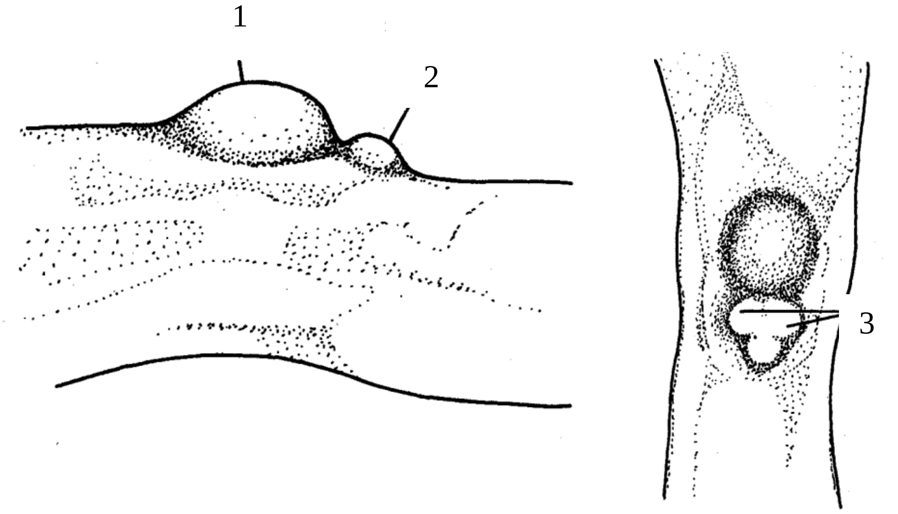
Skin changes. The anterior (extensor) surface of the knee is a frequent site of skin psoriasis. Also pay attention to the presence of erythema (both localized above the bursae, and more generalized with the involvement of the knee joint itself), abrasions or other abnormalities.

SWELLING



11. The normal contour of the knee joint (a), and the swelling when exuding into its cavity (b).

Joint bags/fat pads (fig. 12). Localized swelling in front of the patella indicates prepatellar bursitis. Localized swelling just below the patella, in front of its tendon, indicates superficial infrapatellar bursitis (Fig. 12). A less prominent swelling on both sides of the patellar tendon is characteristic of deep infrapatellar bursitis or a large infrapatellar fat pad (Figure 12). A significantly protruding fat pad on the inside (especially in obese women) can give a large swelling with painful edges medially above or below the articular gap of the knee joint. Less pronounced swelling below the articular fissure can be observed with inflammation of the gooseberry sac (bursa anserina).



12. Swelling in prepatellar bursitis (1), superficial infrapatellar bursitis (2), and deep infrapatellar bursitis (3). Muscle

atrophy. Examine the quadriceps for atrophy (especially useful to compare with the other side in a unilateral lesion). Although the entire quadriceps atrophies, however, the decrease in the volume of the v. medialis (especially in well-developed young men) may be most noticeable. Determining quadriceps atrophy can be difficult, especially in middle-aged and elderly people, and especially in women. Some muscle asymmetry is common and normal.

Deformation. Fixed flexor contracture is best determined when the patient is lying down and trying to straighten his legs. Other deformities may also be noted, but they are usually more noticeable in an upright position.

Position. An idea of the severity of the pain syndrome can be obtained by observing how the patient positions his legs, and how he lowers them and raises them on the couch. With synovitis or strained effusion, causing an increase in intra-articular pressure, the patient will return to the position with bent knee joints.

Palpation

Temperature. Run the back of the hand over the leg from the front and down on each side, comparing the temperature above and below the knee with the temperature of the joint itself. Normally, the knee feels colder than the thigh or lower leg. An increase in temperature may indicate synovitis (common, mostly felt over the entire suprapatellar sac) or bursitis (localized). If an increase in temperature is detected, it is necessary to exclude the presence of varicose veins as its causes, most noticeable in the vertical position of the patient.

The presence of fluid in the joint cavity can be determined by one of three methods •

* Symptom of protrusion. This method detects small amounts of fluid (and does not necessarily indicate pathology). Fix the patella, at the same time gently massaging down on both sides of it in turn and observing the pits on the opposite side. Small amounts of liquid can pass from one side of the bag to the other.

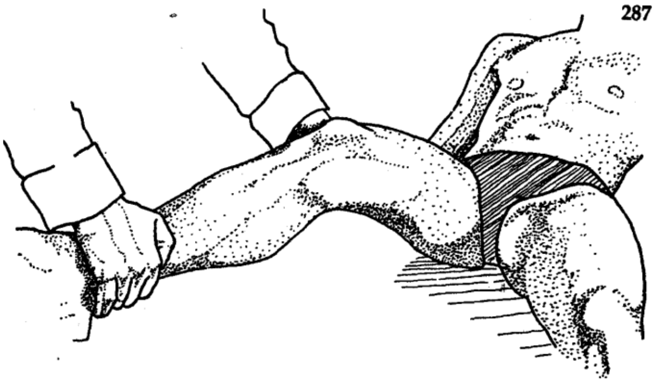
* Balloon symptom (fluctuation). With the accumulation of a moderate and significant amount of fluid, the bulging symptom usually disappears, but becomes a positive balloon symptom. Place the palm of one hand on the patella, and the thumb and the other four on the medial' and lateral sides. Then, tightly clasping it, press down and inwards with the palm of your hand-this will automatically direct the fluid towards the main cavity in the area of the knee joint gap. If you now press on the patella or lower part of the joint with the second hand, the first hand will feel an increasing pressure (fluctuation). This is the most sensitive test for the presence of fluid in the knee joint cavity.

Palpation of the joint fissure area. To determine the joint gap, place the knee in a slightly bent state. At the same time, the midline will easily identify the tubercle of the tibia pain, which can be painful in Osgood-Schlatter disease. If you move the palpating finger medially and then proximally from the tubercle, it will fall on the plateau of the tibia. With further upward ascent, the anterior line of the articular fissure will be determined in the form of a wide recess back between the tibia (below) and the femur (above). The internal and external rotation of the lower leg will open, respectively, the lateral and medial parts of the articular fissure, which makes it easier to identify it in complex cases (for example, in obese patients). Having identified the anterior medial part of the articular fissure, press your finger directly near the patellar tendon and, pressing in this way, go along the entire inner part of the articular fissure. Soreness defined only in the anteromedial region is characteristic of damage to the medial meniscus, whereas more generalized soreness of the medial part of the articular fissure / joint capsule suggests some kind of arthropathy. Repeat this examination for the lateral part of the articular fissure. Local soreness is again more characteristic of meniscus pathology, and generalized soreness is more characteristic of arthropathy. Palpating both anterior parts of the articular fissure, the doctor assesses the presence of any soft-tissue swelling. Thickening of the synovial membrane can give fullness along both anterior articular lines with a visible bulge: when pressed, it disappears, but immediately reappears immediately after the pressure ceases. This symptom may be a false positive when determining the thickening of the synovial membrane in the case of a significant sub-patellar fat pad, giving the same sensations. Another cause of swelling on both sides of the patellar tendon is deep infrapatellar bursitis. However, it may be accompanied by hyperthermia, a positive balloon symptom, and have clearer internal and external boundaries. Local swelling only on the lateral side, and sometimes on the medial side, can be a manifestation of a meniscus cyst. This formation can protrude from the surface of the joint gap and disappear when the knee joint is flexed/extended.

Stability. Although there are a large number of tests to detect joint instability, none of them are strictly specific to a single injury. The following are standard screening tests for the detection of tendon or joint capsule lesions.

Collateral ligaments

The stability assessment is performed in the "unlocked" joint in a state of light flexion (when the knee is straightened, the cruciate ligaments also prevent lateral displacement) (Fig. 13, a). Push the thigh medially with one hand and the lower leg laterally with the other, observing the excessive movement of the lower leg to the side (instability of the medial collateral ligament). The method of holding the leg is not essential if sufficient leverage is created to demonstrate this symptom (some clinicians place the patient's foot in their armpit, and their hands tightly wrap around their lower leg so that more effort can be applied) (Figure 13, b).



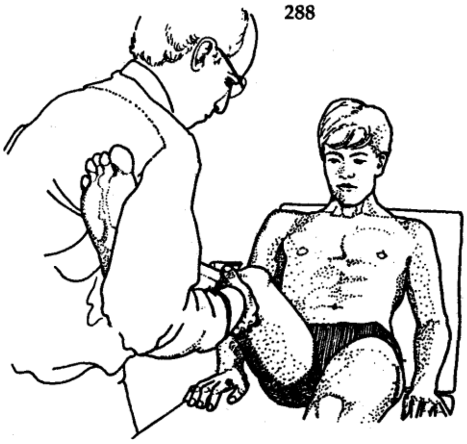


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Figure 13. Medial ligament load test.

In addition to the lateral offset, also pay attention to:

* opening of the medial part of the articular fissure (a symptom of a gap);

* pain in the medial part of the knee joint, especially at the site of the lower attachment of the tendon, indicating enteropathy of the collateral ligament. (This technique is mainly a stress test for the medial collateral ligament).

The lateral collateral ligament is examined in a similar way with a slightly bent knee. The doctor pushes the lower leg medially and the hip laterally. Again, look for excessive lateral displacement, a gap symptom, and the appearance of pain.

Cruciate ligaments

These ligaments are examined when the knee is bent to 90 degrees and the hip joint is bent to 45 degrees (Fig. 14).

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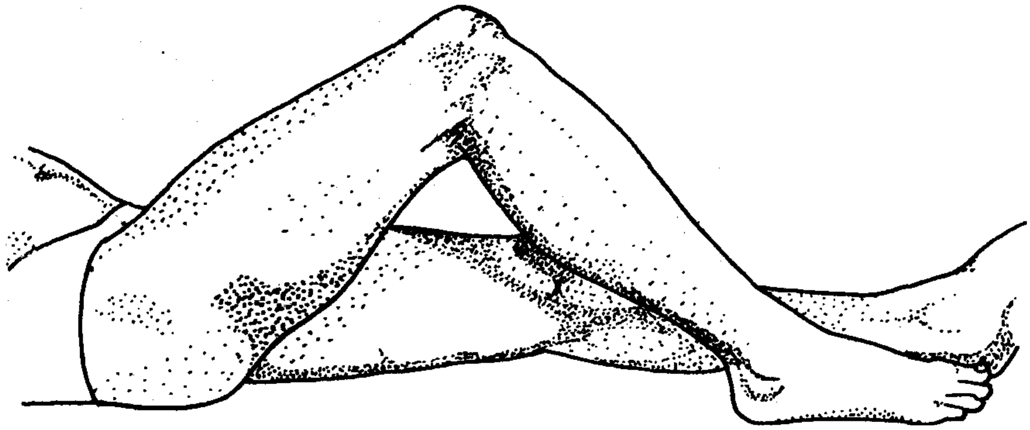


Fig. 14. The position for the study of the cruciate ligaments.

Before testing for excessive mobility:

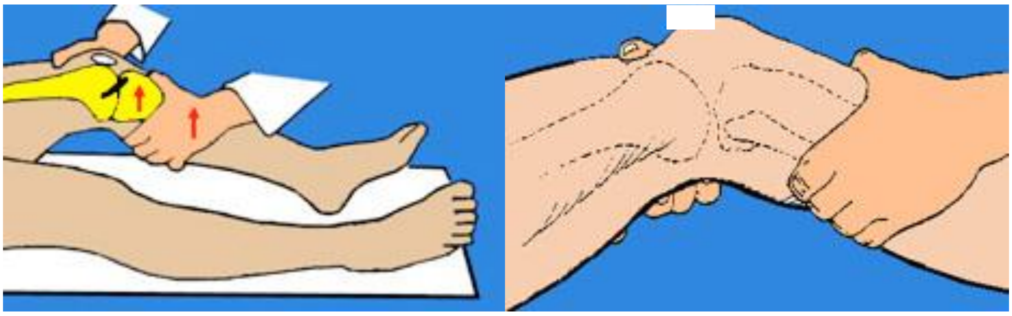
* palpate the posterior thigh muscles and make sure that they are sufficiently relaxed (otherwise they may hinder the movement of the lower leg back and forth, hiding the instability of the cruciate ligaments).

* Examine the rounded contour of the knee joint from the side to make sure that the tibia is not initially in a state of subluxation posteriorly (a symptom of posterior "failure") as a result of instability of the posterior cruciate ligament.

After that, check the test for the presence of excessive anteroposterior mobility of the upper leg in relation to the femur. After stabilizing the lower part of the lower leg with one hand, try to move the upper part back and forth with the other (see Figure 39), the weight of the patient will keep the hip stationary. Some doctors prefer to sit on the foot to ensure the immobility of this part of the leg. However, this is not necessary and may cause pain in patients with arthropathy of this localization or other injuries to the foot. If excessive mobility of the lower leg is detected (a symptom of an "anterior drawer"), this may indicate instability of the anterior cruciate ligament, destruction of cartilage, or generalized hypermobility.

Comparison with the second knee joint, performing other tests for hypermobility allows you to correctly interpret the data of that test. If the lower leg moves posteriorly, this excessive movement indicates instability of the posterior cruciate ligament.

The Lachman test (Figure 15) is a sensitive method for detecting damage to the anterior cruciate ligament (especially the posterolateral fibers).



15. The Lachman test.

The knee should be slightly bent (30 degrees) and relaxed. Wrap one hand around the thigh, and the other around the upper part of the lower leg and pull the latter forward to reveal excessive mobility and a soft "final feeling" (this requires good relaxation from the patient and sufficiently large hands of the doctor).

If the anterior drawer symptom is positive, the Slocum test can be performed to determine antero-lateral and antero-medial instability (Figure 16).

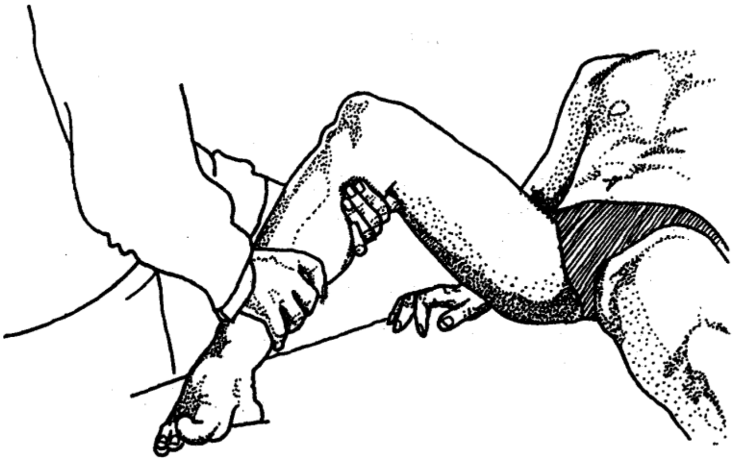


Figure 16. The Slocum test.

In the patient's position as for the "front drawer" test, sit on the couch and passively rotate the tibia inward 30 degrees, holding it in this position on the couch, placing the foot near your buttocks. With this technique, you strain the lateral part of the joint capsule, providing the joint with sufficient stability for the disappearance of the "front drawer" symptom. If the test remains positive after that (most of the forward movement is on the lateral side), then this indicates the possibility of damage to the lateral part of the capsule and / or the lateral collateral ligament. Similarly, strain the outer part of the capsule: a positive "front drawer" symptom in this position (forward movement is mainly due to the medial part) usually indicates damage to the medial fibers of the joint capsule and / or the medial collateral ligament.

Additional tests for mechanical damage.

If anamnesis (e.g. joint blockage) or research suggests that the cause is primarily mechanical, the following tests may be useful for clarification:

A change in the axis of rotation (McIntosh's symptom) (Figure 17). As another test for detecting antero-lateral rotational instability, it allows you to demonstrate a dynamic subluxation in which the tibia slides laterally and forward along the femur. The patient lies on his back, the hip joint is bent at an angle of 20 degrees and relaxed with a slight medial rotation, the knee is slightly bent (5 degrees). The examiner rotates the lower end of the lower leg inwards with one hand, while the other hand pushes the upper part of the lower leg forward along the thigh, simultaneously exerting pressure inwards.

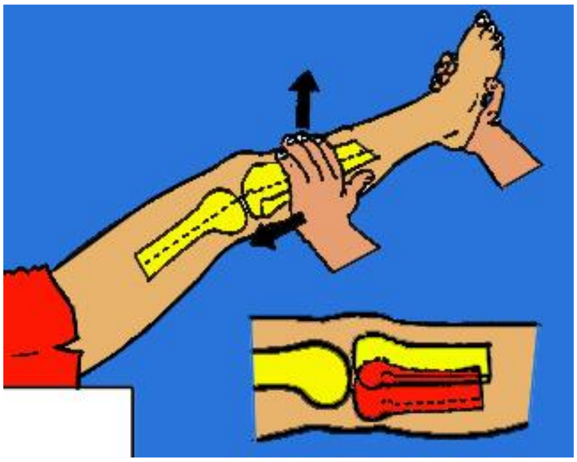


Figure 17. The MacIntosh symptom.

If you then bend the knee to an angle of 30-40 degrees, the shin suddenly jumps back with a characteristic click. The rebound is caused by the ilio-tibial tract, which switches from the extensor to the flexor function and pulls the tibia to its normal position. Normally, the center of rotation of the knee joint constantly changes during movement as a result of the shape of the condyles of the femur, the tension of the ligaments and the traction of the muscles. A positive symptom of a change in the axis of rotation usually indicates damage to the anterior cruciate, lateral collateral ligaments, or posterolateral joint capsule.

A symptom of a mediapatellar fold. The pain provoked by the displacement of the patella inwards with the knee joint bent at an angle of 30 degrees can be caused by the infringement of the fold of the synovial membrane between the condyle of the femur and the patella.

A symptom of "anxiety". If you carefully move the patella to the lateral side with the knee bent at an angle of 30 degrees, the patient may resist, strain the quadriceps muscle of the thigh and express concern if he has recurrent subluxations of the patella.

BRUISING AND HEMARTHROSIS OF THE KNEE JOINT

Hemarthrosis can be caused by a bruise, a torn ligament, a meniscus, a fracture of the patella, the condyles of the femur or tibia, or a dislocation of the lower leg.

Clinic:

Knee pain, mainly felt on the anterior surface, often with localization in the affected area;

The swelling (Fig. 18) is first determined in the recess on the inner side of the patella, and then extends to the suprapatellar inversion, forming a typical "horse saddle" type appearance above and on both sides of the patella;

A symptom of protrusion with a moderate amount, a symptom of balloon (fluctuation) with a significant amount of blood in the joint cavity.

The knee joint is examined clinically and radiologically (if necessary, arthroscopy) to diagnose damage.

The treatment strategy is determined by the nature of the intra-articular injury. In the acute period, a puncture of the knee joint is performed

Puncture of the joint is usually performed at the level of the middle of the patella, retreating 1-1. 5 cm from the outer or inner edge of it. After the puncture, the skin is shifted and only then the needle is pushed through the remaining layers of tissue. This is done so that the channel after removing the needle is broken (for better isolation of the joint from the surface of the skin). The pressure on the upper inversion moves the fluid into the joint cavity, which facilitates the suction of its contents.

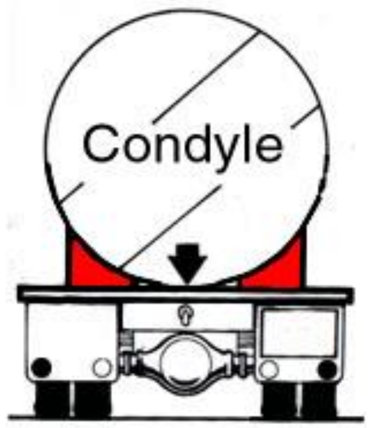
Puncture of the upper inversion is performed at the lateral edge of the patella at the level of its upper edge, and the pressure on the patella moves the fluid into the upper inversion of the joint. Then, if necessary, apply a pressure bandage.

The" gold standard " for determining the treatment tactics for hemarthrosis of the knee joint is early therapeutic and diagnostic arthroscopy.

MENISCAL INJURIES

The most frequently damaged (from 55 to 85%) among the elements of the knee joint are the menisci. The frequency of these injuries is due to a large proportion of the load on the menisci, as well as the peculiarities of their anatomical location and functions. Meniscal injuries are more common as a result of violent rotational forces acting on the knee joint, while the lower leg is loaded with body weight.

- The role of the meniscus (fig. 19):



stabilization role – uniform load distribution over a large surface;

amortizatory role-reduction of shocks and concussions during movement;

elimination of mismatch of articular surfaces;

 prevent the capsule from being pinched during movement;

proprioceptive role-the menisci are proprioceptive structures, providing a feedback mechanism for determining the position of the knee joint. This confirms the presence of type I and type II nerve endings in the anterior and posterior horns of the meniscus;

providing "lubrication" during the movements of the joint elements due to the redistribution of joint fluid

The clinic.

Diagnostic measures for meniscus injuries consist of the study of the mechanism of injury, clinical diagnosis (the use of tests and symptoms), X-ray and radiation diagnostics, and usually, the final method is diagnostic arthroscopy.

In the chronic period: pain when pressing on the joint gap (Fig. 20).

Figure 20 . The point of soreness when the internal meniscus is damaged.

MacMurray test: the thumb of one hand is placed on the area of the inner joint gap of the knee joint. The knee joint is in the middle position between flexion and extension. The opposite arm is wrapped around the foot, extension and external rotation are performed with simultaneous pressure along the axis of the lower leg. The patient notes an increase in pain (Fig. 21).

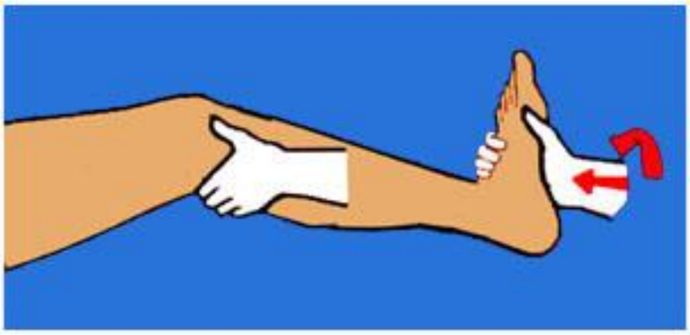


Figure 21. Mcmurray Test

Apple test: Patient on stomach. The knee bends at a right angle. The pressure is carried out along the axis of the lower leg and rotation. The appearance of pain from the outside implies damage to the inner meniscus, from the inside – to the inner one (Fig. 22).

Figure 22.Apple test.

A positive symptom of the" extension " of N. I. Baykov: pressing a finger on the joint gap while simultaneously extending the lower leg increases the pain.

Tailor's symptom of V. D. Chaklin: atrophy of the medial broad thigh muscle and compensatory thickening of the tailor's muscle.

G. I. Turner's symptom: increased pain and temperature sensitivity in the medial fissure of the knee joint.

Symptom of "stairs" V. P. Perelman: increased pain when descending from the stairs.

The final block of the Généty is determined by a deficit of extension in the knee joint of 5-10 degrees (Fig. 23).

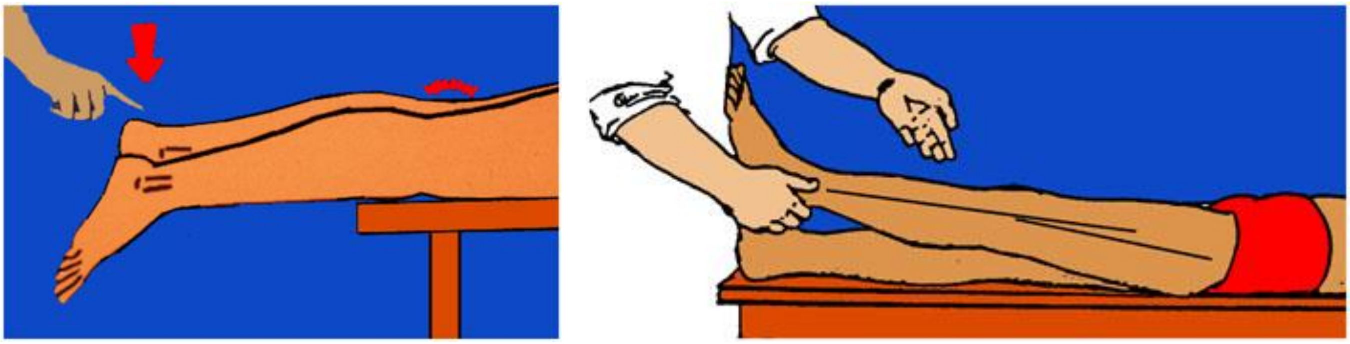


Fig. 23. The final blockade of Généty.

The symptom of the" palm " of A.M. Landa: between the knee joint and the plane of the table, you can hold your palm.

Increased pain when the lower leg rotates outward (Steinman's symptom) and inward (Burchard's symptom).

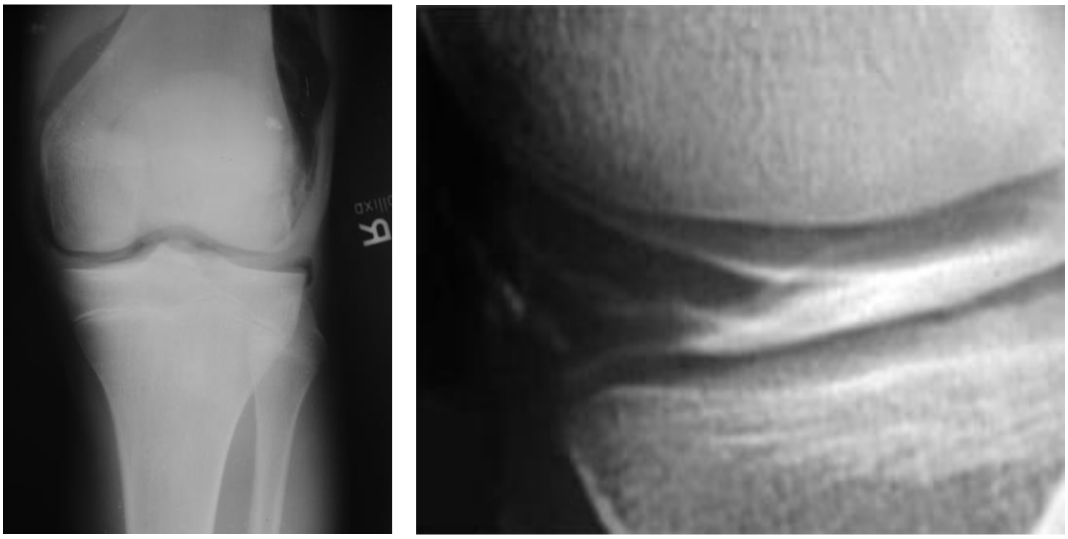
Symptom of a muscle brake: with a rapid passive extension of the lower leg, the patient slows down the movement by a sharp contraction of the muscles.

Bringing and withdrawing the straightened lower leg increases the pain (a positive symptom of the" click " of V. D. Chaklin).

It is known that none of the clinical tests and symptoms are pathognomonic to meniscus rupture and their diagnostic value varies widely. Clinical diagnosis of meniscal injuries remains relevant today, but in most cases, additional research methods are required to solve the diagnostic problem.

Functional research methods:

1. Pneumoarthrography. Some help in the diagnosis of meniscal injuries is provided by contrast radiography of the knee joint. The gas introduced into the joint cavity fills the free space and forms a shadow of less intensity on the X-ray image than soft tissue formations. Standard radiography is performed in two projections after the introduction of oxygen into the joint cavity (pneumoarthrography).



24. Pneumoarthrogaphia.

However, the diagnostic accuracy for meniscal injuries using contrast arthropneumography leaves much to be desired. Thus, according to different authors, the discrepancy between clinical and radiological and postoperative diagnoses ranged from 10 to 60%. In addition, when using this method, such complications as subcutaneous emphysema of the thigh, purulent gonitis, air embolism, synovitis are possible.

2. Magnetic resonance imaging (fig. 25). When conducting magnetic resonance imaging in the study of the meniscus of the knee joint, 5 mm sections are used, giving from 16 to 18 projections of the joint. The study begins with the peripheral region of the medial meniscus and moves to the center through the interstitial elevation. The body of the medial meniscus is defined by a homogeneous dark formation curved in the form of an arc between the articular surfaces of the condyles of the femur and tibia. The height of the peripheral edge of the meniscus on MRI is 3-5 mm, in the direction of the center of the meniscus gradually taper thinned. The third section of the MRI passes through the free edge of the meniscus, the anterior and posterior horns of the meniscus can be evaluated on the second and third MRI planes, respectiv ely.

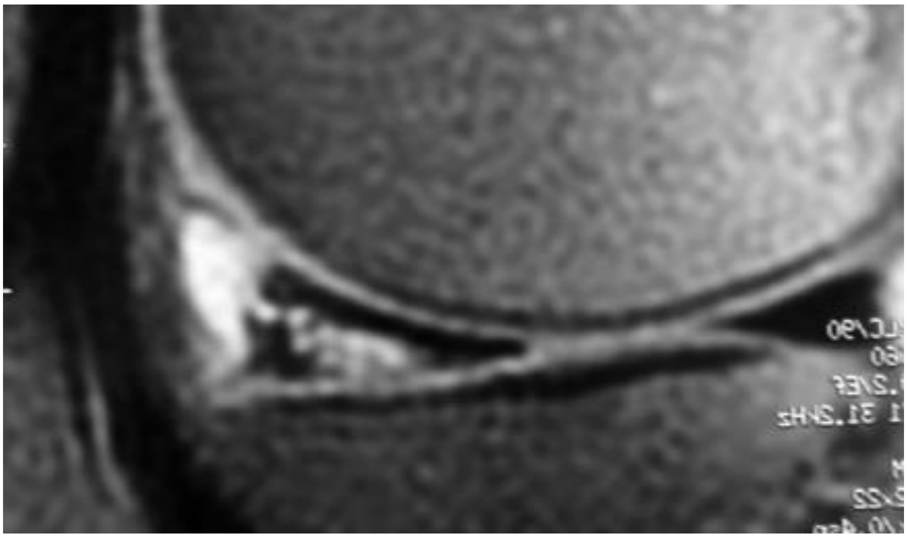
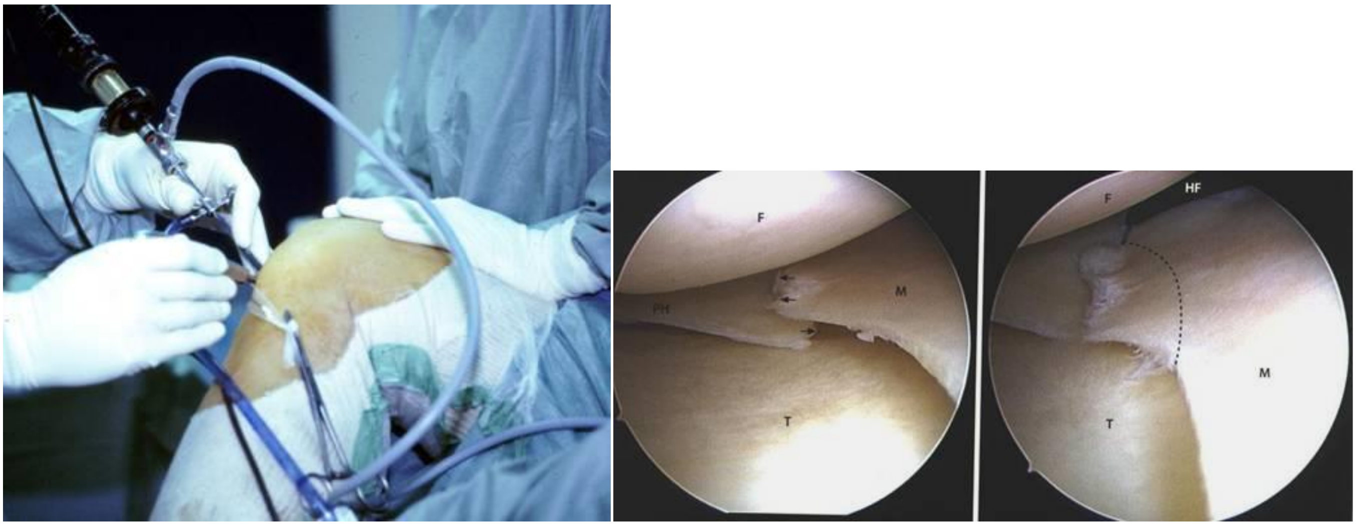


Figure 25. Magnetic resonance imaging

As in the arthrogram, the meniscus is triangular in shape with a sharp central edge. In the area of the inter-condylar elevation, the horns of the meniscus merge almost imperceptibly with their attachment area. On MRI, the meniscus tissue is homogeneous, dark without additional internal signals. Being a non-invasive method, MRI for meniscal pathology approaches diagnostic arthroscopy in terms of its diagnostic capabilities, which makes it possible to solve diagnostic problems in almost 50% of cases.

3. Arthroscopy (fig. 26). The insufficient prevalence of radiation diagnostic methods in clinical practice, the complex interpretation of the study data, and the existing significant percentage of incorrect diagnosis, leave the arthroscopic method as the decisive type of diagnosis of the pathology of the meniscus of the knee joint. Arthroscopy is a method of visual examination of the structures and contents of the joint cavity, as well as therapeutic effects on them with the help of thin optical and mechanical devices. Minimally invasive operations used in arthroscopic surgery are far superior to the traditional open arthrotomy technique. The ability to examine all parts of the joint without disturbing the relationship of its structures, the highest diagnostic efficiency and low trauma of manipulations based on accurate knowledge of the anatomy of the injury, planning the volume of operations, minimal access to the joint cavity and precision techniques of arthroscopic reconstructive operations-this is a far incomplete list of advantages of arthroscopy over traditional knee surgery.



26. Arthroscopic method of the knee joint

Types of damage.

Of the large number of common classifications of meniscal injuries, there is no one that would quite succinctly determine not only the type of damage, but also the most appropriate nature of surgical intervention in each specific case. In these circumstances, it is not only the type of anatomical rupture of the meniscus tissue that is important, but also the relationship of the anatomy of the meniscus rupture to its blood supply to determine the potential for reconstructive surgery.

Depending on the localization, damage is distinguished

* bodies,
* rear horn,
* anterior horn.

In addition, the relationship of the anatomy of the meniscus rupture to its blood supply may be important for determining the potential for reconstructive surgery (meniscus suture). In this regard, there are zones (Kuznetsov I. A):

* avascular, central part;
* border of the avascular and blood supply zones;
* vascular part of the meniscus;
* the vascular part of the joint capsule.

To determine the type of damage, the most common classification is Kohn (1991)(Figure 27).

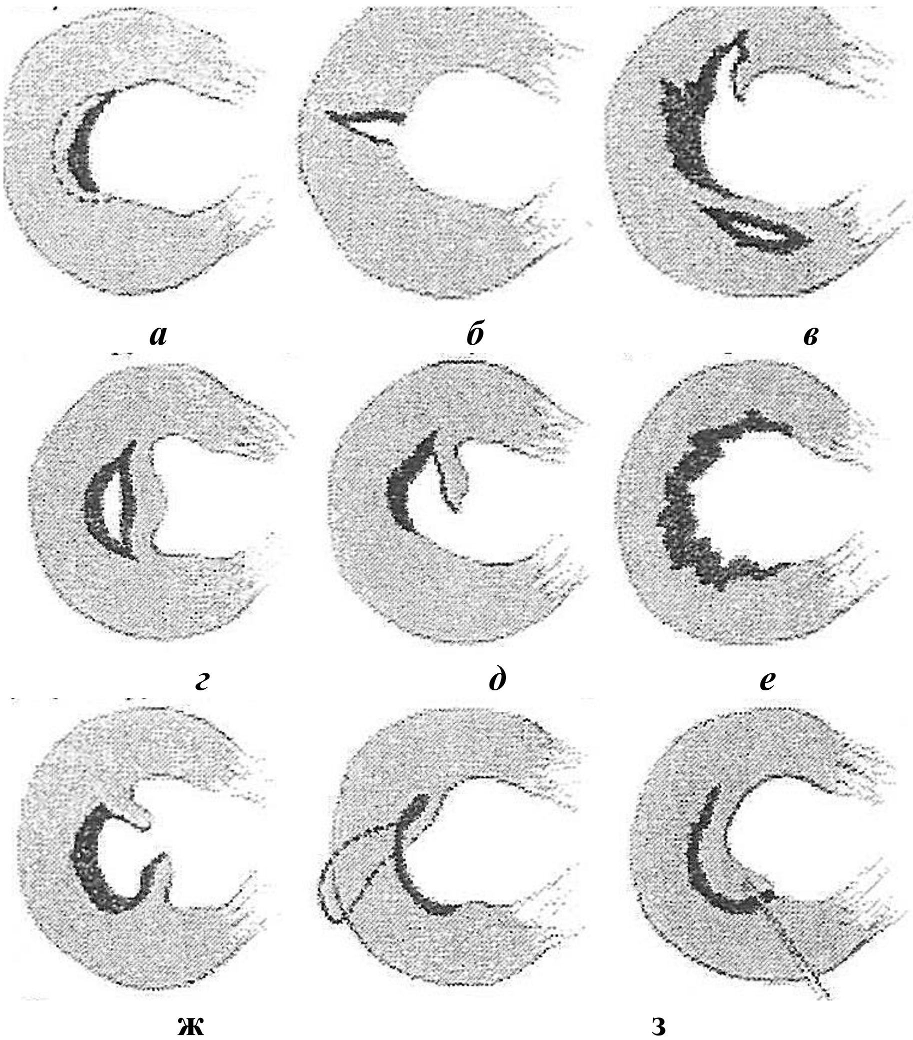


Fig. 27. Classification of damage to the menisci and the horizontal, b radial (transverse); b – complex (complex); d – longitudinal (including ruca heads"); d – patchwork; e – degenerative; W – patchwork gap "handle the Leica"; z – flap on the leg (for D. Kohn, 1991).

Differential diagnosis:

Traumatic synovitis – acute or chronic. Accumulation of effusion in the cavity of the knee joint. Joint pain goes away after 2-3 weeks.

Damage to the cruciate ligaments – the symptom of the "drawer" is positive.

Damage to the lateral ligaments – instability, lateral swing of the lower leg.

Goff's disease is a fibrous degeneration of the adipose tissue of the pterygoid folds of the knee joint as a result of an acute single or repeated minor injury.

Koenig's disease is an aseptic necrosis of the articular cartilage and bone of the medial condyle of the femur.

Damage to the articular cartilage – persistently recurrent blockages. Before calcification, the shadows in the joint are not visible radiologically.

Articular muscles-the separation of a piece of articular cartilage with or without bone, the compaction of fallen fibrin in hemarthrosis, as a result of Koenig's disease.

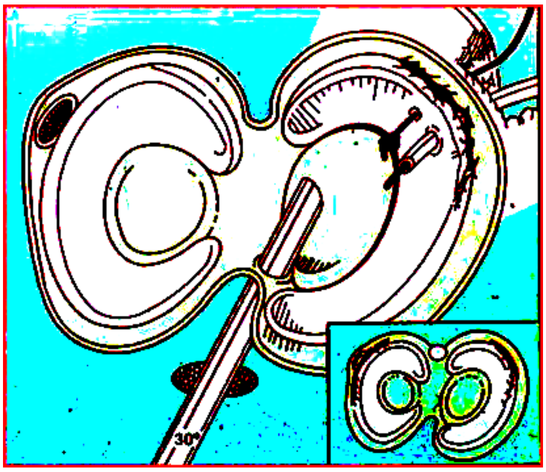
Meniscus cyst-the external meniscus is more often affected. Aching pains increase when walking. Leads to the development of deforming arthrosis.

Treatment:

The most common complication of meniscal injuries is the progressive destruction of the articular surfaces of the bones articulating with the damaged meniscus. According to E. D. Beloenko et al. (1997), in the first 3 months after the meniscus injury, a pathological reaction of the surrounding cartilage occurred in 32% of patients, in 3-6 months - in 45.2%, and in 6-12 months - in 71%. This circumstance should be taken into account when choosing a therapeutic tactic. In doubtful cases, diagnostic arthroscopy can solve these problems with minimal losses to the health of the victim.

The meniscus is a vital structure in the distribution and cushioning of the load in the knee joint, and if it is absent, this circumstance contributes to the rapid progression of degenerative-dystrophic processes in the joint, and the amount of degenerative changes in the articular cartilage is directly proportional to the size of the removed part of the meniscus.

Types of operations.

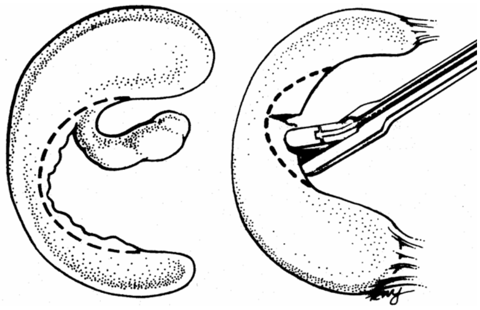


Meniscus suture (fig. 28). Convincing evidence of the possibility of healing damaged meniscus tissue has formed a large group of researchers to develop various methods of meniscus suture in practice arthrotomic and arthroscopic operations.

It is determined that the meniscus suture will be more successful if the treatment is subject to a longitudinal fresh tear in the vascularized zone of the meniscus in a young individual in a stable knee joint. Thus, this operation can be rational if the meniscus is damaged in the peripheral blood supply zone, especially if it is performed using arthroscopic techniques.

Replacement of the meniscus. It is not always possible to preserve the meniscus with its massive traumatic damage. One possible solution in these situations is meniscus transplantation. The new solution to this problem raises many questions concerning the selection, preparation and preservation of the graft, the technique of surgical intervention, postoperative management of such patients, etc. Meanwhile, experimental data suggest that the transplanted meniscus is not damaged by enzymes and immunohistochemical reaction and can "take root" by the type of healing when it is stitched. A few clinical observations have also shown the possibility of survival of transplanted menisci after transplantation for several years. However, this issue is further explored.

Arthroscopic resection of the meniscus (fig. 29). All the known advantages of arthroscopic methods of diagnosis and surgery have been fully realized in clinics that possess endoscopic methods of surgery, on the example of improving surgical treatment for meniscal injuries. The first convenience for the surgeon when using endoscopic methods of surgery is an improved examination of the meniscus compared to its revision through one or more arthrotomic approaches.



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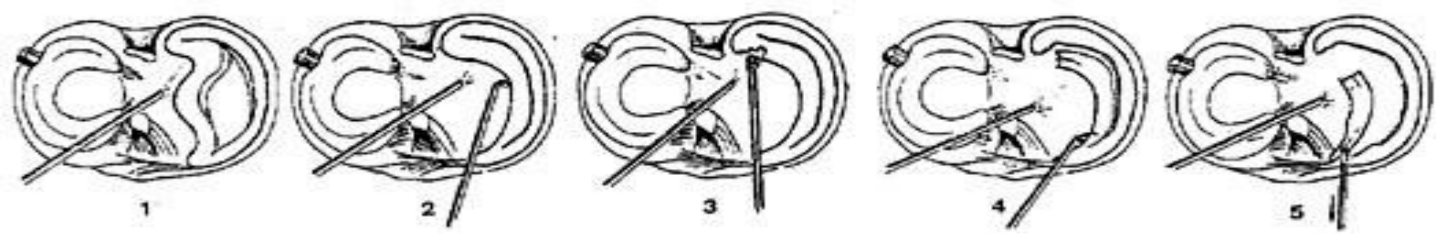
29. Arthroscopic resection of the meniscus: a - resection contours of the flap tear; b - resection of the radial tear.

With the use of an arthroscope, the surgeon has the opportunity to examine the entire meniscus, including its posterior parts and the adjacent synovial membrane, as well as to assess all the features of the knee joint where the operation is to be performed, which significantly increases the accuracy. With the help of endoscopic instruments, it is possible to perform the most careful resection of only the damaged area of the meniscus, while preserving all other viable parts. When performing the full required volume of the operation, the membranes, innervation and blood supply to the joint are preserved inside the joint, which ensures a rapid restoration of its function. Figure 30 shows the main stages of arthroscopic resection of the internal meniscus when it breaks in the form of a "watering can handle"..



30. Stages of arthroscopic resection of the internal meniscus when it breaks in the form of a "watering can handle": 1 - diagnosis; 2 - reduction; 3 - cutting off the flap at the posterior horn; 4 – cutting off at the anterior horn; 5 – extraction of the resected part.

DAMAGE TO THE CAPSULAR LIGAMENTOUS APPARATUS

The second place after meniscus injuries is occupied by various degrees of severity of damage to the capsule-ligamentous apparatus (CSA) of the knee joint (up to 52%). These injuries often occur during sports, especially contact sports (football, hockey), as well as those where it is often possible to experience severe stress (skiing, gymnastics, etc.). A large number of road accidents, especially involving motorcycles, as well as the injury of a car passenger in a collision with the impact of the bent knee joints on the dashboard, are also common causes of damage to the CSA of the knee joint.

The mechanism of injury. Ligamentous structures are more often injured as a result of indirect impact transmitted by the bones of the joint, less often with direct trauma.

There are 4 main mechanisms of rupture of the capsule-ligamentous structures of the knee joint:

1. Abduction, flexion and external rotation of the lower leg relative to the hip (Fig. 31, 1) - the most common mechanism that occurs in sports competitions, when the forces of abduction and flexion develop in the knee joint, and the lower leg rotates outward relative to the hip along its longitudinal axis under the influence of body weight. Such a mechanism causes damage on the medial surface of the knee joint, the severity of which depends on the magnitude and dispersion of the applied force. Initially, the damaged structures will be the tibial collateral ligament complex. If the action of the damaging force continues, then the anterior cruciate ligament is further involved. At the same time, the medial meniscus can also be damaged.

2. Adduction, flexion and internal rotation of the lower leg relative to the hip (Fig. 31, 2) - occurs somewhat less frequently and causes damage to the lateral part of the CSA of the knee joint. First, the peroneal collateral ligament is damaged and then, the tendons of the popliteal and biceps muscles, the tractus iliotibialis, the peroneal nerve may be affected and in the final action of these forces, one or both cruciate ligaments are involved.

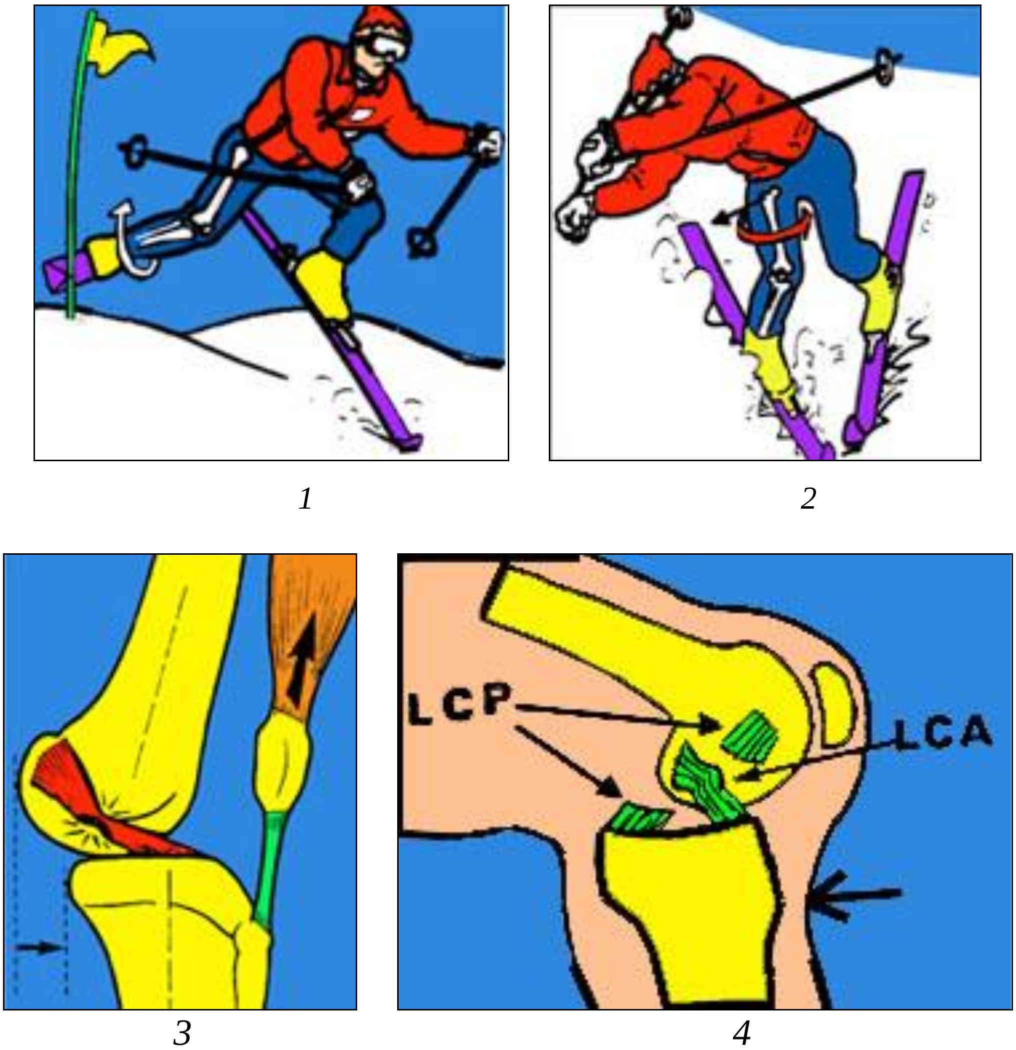


Fig. 31. Mechanisms of KSA damage.

3. Overextension in the knee joint (Fig. 31, 3) - forces acting in a direct direction on the unbent knee joint, causing hyperextension, usually cause damage to the anterior cruciate ligament or, if the forces act for a long time and with great force, stretching occurs, followed by rupture of the posterior capsule of the joint and the posterior cruciate ligament.

4. Anterior-posterior displacement of the lower leg (31, 4)-forces acting on the bent knee joint in the anterior - posterior direction, as in a typical injury-impact on the dashboard of a car, cause or damage to the anterior or posterior cruciate ligament, depending on the direction of displacement of the lower leg.

There are 3 degrees of instability of the knee joint, which is manifested in the study of the joint using load tests and is denoted by (+):

* 1 (+)shows that the articular surfaces diverge within no more than 5 mm;

* 2 (++) shows that the discrepancy is from 5 to 10 mm;

* 3 (+ + +) indicates that the discrepancy exceeds 10mm.

The resulting instability of the knee joint can only be determined by the direction of displacement of the lower leg relative to the hip. There are the following classifications of instability of the knee joint with damage to its ligamentous groups:

A. Single-plane instability (simple or direct) Single-plane

medial

Single-plane lateral

Single-plane rear

Single-plane anterior

B. Rotational instability

Antero-medial

Antero-lateral

Posterior-medial

Posterolateral

B. Combined instability

Antero-lateral-postero-lateral rotational

Antero-lateral-antero-medial rotational

Antero-medial-postero-medial rotational

The main complication that occurs with untreated joint instability is a rapidly developing degenerative-dystrophic process of articular cartilage, clinically expressed in the form of deforming arthrosis.

Chronic instability of the knee joint is the cause of the development of deforming arthrosis in 21-29.5% of patients

The longer the period after the injury, the more signs of the destructive process of the cartilage cover of the joint begin to prevail in the clinic of chronic instability.

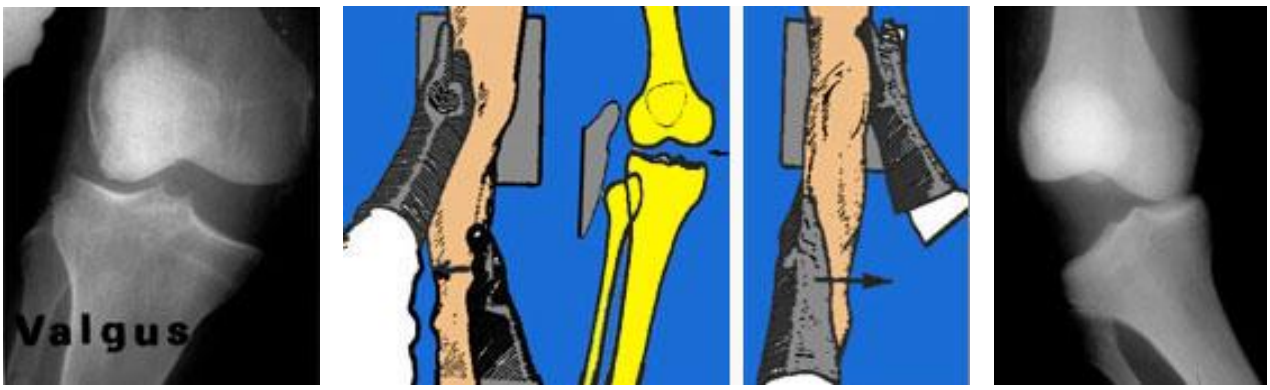
Radiography.

Overview radiography in two projections is the main diagnostic procedure for determining the separation of ligamentous structures with a bone fragment of attachment and detecting possible concomitant diseases or joint dysplasia. Most often, this method reveals the separation of the anterior cruciate ligament with a bone fragment of the inter-condylar elevation (Fig. 32), especially in adolescent patients.

32. separation of the anterior cruciate ligament with a bone fragment of the inter-condylar elevation.

X-ray examination of the knee joint with damage to the tibial collateral ligament complex can reveal the presence of a bone fragment in the area of attachment of the ligament to the supracondyle of the femur.

In order to objectify the X-ray examination and to assess the degree of damage to the ligamentous structures, there is a method of stress radiography (Fig. 33).



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33. Stress radiography: a - in case of damage to the internal lateral ligament; b - in case of damage to the external lateral ligament.

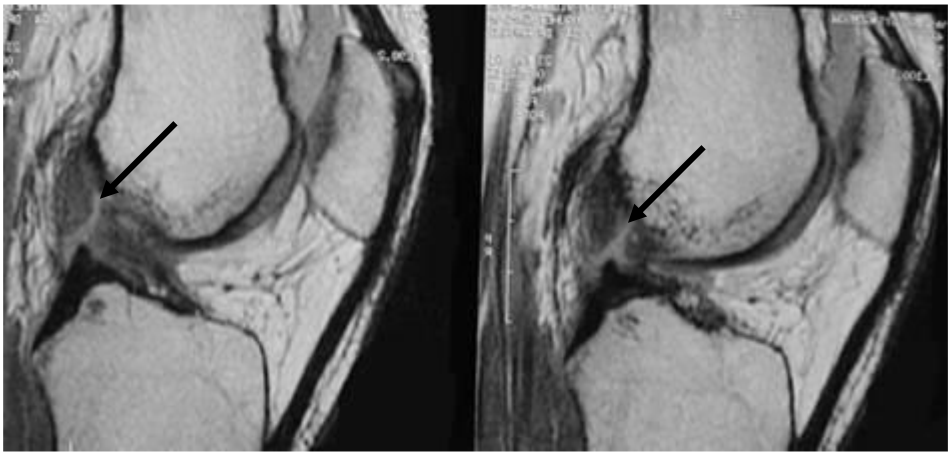
Magnetic resonance imaging

Modern methods of magnetic resonance imaging can determine both the normal state of the cruciate and collateral ligaments, and their pathology.

The appearance of the PKS on MRI is represented as a continuous black (low intensity) formation, with different densities (Fig. 34).

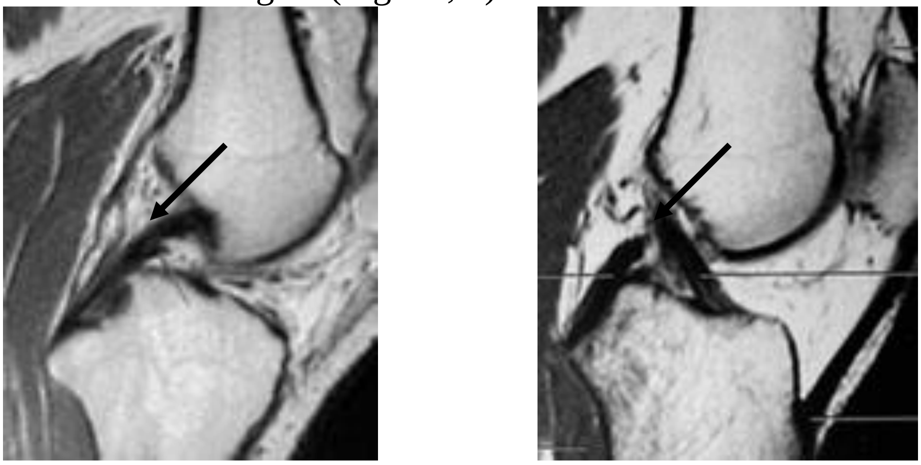
34. MRI of the knee joint, the arrow indicates the anterior cruciate ligament is normal.

In acute damage, the PKS is represented as a thin fiber disjointed or a sinuous line or an excessively concave upper shadow of the ligament. A hematoma is often found in the area of the femoral attachment of the ligament, the localization of the most frequent place of rupture (Fig. 35).



35. MRI of the knee joints: the arrow indicates ruptures of the anterior cruciate ligament and a hematoma.

The posterior cruciate ligament (RCC) on MRI has a clearer structural appearance than the RCC (Fig. 36, a). The rupture of the RCC is manifested by a violation of the regularity of the ligament fibers, the expansion of its shadow and the amplification of the signal (Fig. 36, b).



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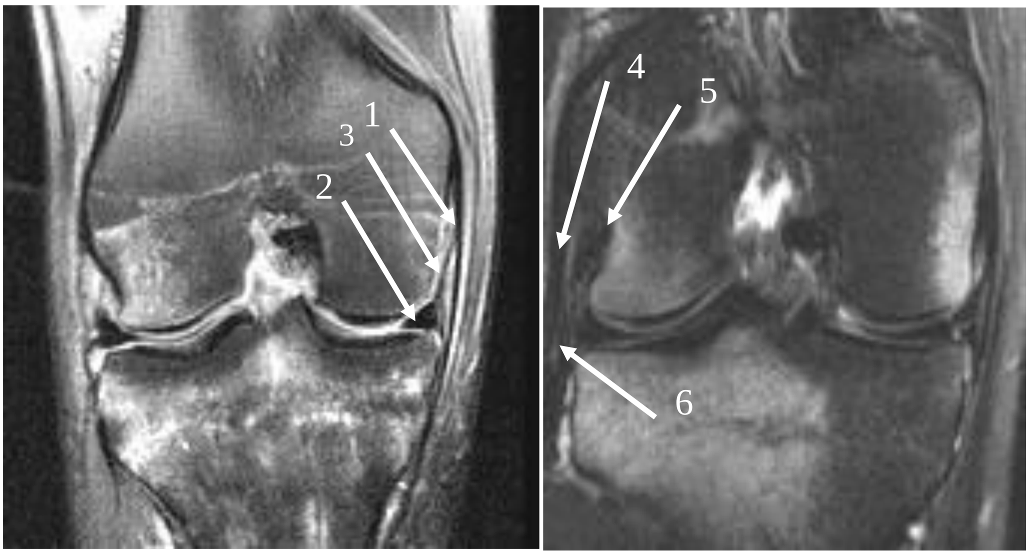
36. MRI of the knee joints: a-posterior cruciate ligament is normal; b-rupture of the posterior cruciate ligament.

The tibial collateral ligament is represented on MRI (Fig. 37, 1)by dark, thin beams of low intensity extending from the medial epicondyle of the femur to the proximal medial metaepiphysis of the tibia. They are intertwined with the dark contours of the cortical sections of the femur and tibia. Normally, the gap between the medial capsular ligaments and the attachment of the menisci is determined (Figure 37.2) due to the presence of bursa or adipose tissue (Figure 37.3).



37. MRI of the knee joint.

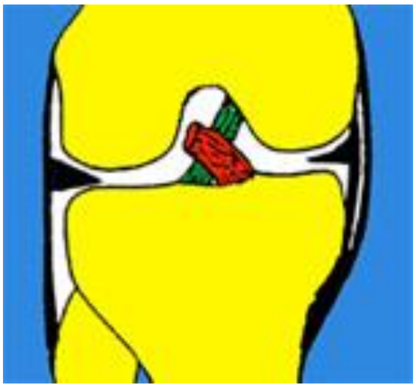
On the lateral surface of the knee joint, the following supporting structures are normally distinguished on MRI: the fibular collateral ligament (Fig. 37,4), which runs from the lateral condyle of the femur somewhat obliquely and posteriorly in the distal direction, intertwining there with the second structure - the biceps tendon (Fig. 37,6).

Hamstring tendon (Fig. 37, 5) - the third structure of this division, which begins proximally just below the area of the departure of the peroneal collateral ligament from the femoral condyle, then turns medially and penetrates the lateral meniscus, the last formation-tractus iliotibialis. Its location is more ventral than the others, the tractus runs parallel to the femur and attaches to the Gerdy tubercle on the lateral condyle of the tibia.

All medial and lateral supporting ligaments should be homogeneously dark on MRI and have clear, straight contours when the knee joint is bent. Any expansion of the contours, violation of their length, displacement, increase in signal intensity, as well as tortuosity of the edges of the structure are regarded as symptoms of damage.

CRUCIATE LIGAMENT INJURIES:

The most frequently damaged ligamentous structure of the knee joint is the anterior cruciate ligament (fig. 38)



38. Damage to the anterior cruciate ligament.

When the cruciate ligaments are torn, there is a sharp pain. There is bleeding in the joint (hemarthrosis). The joint increases in size. There is a symptom of" balloting " of the patella. However, for some patients, the moment of injury itself may go unnoticed. Later, there is a feeling of instability, looseness in the knee joint.

The main symptom of a cruciate ligament rupture is considered to be a "drawer" symptom (Fig. 39). With the help of special techniques, the doctor moves the patient's lower leg forward or backward. When the anterior cruciate ligament is torn, the lower leg is excessively displaced forward – a symptom of the "front drawer", and when the posterior cruciate ligament is torn, the lower leg is easily displaced backward-a symptom of the "rear drawer". The remaining symptoms are presented above.

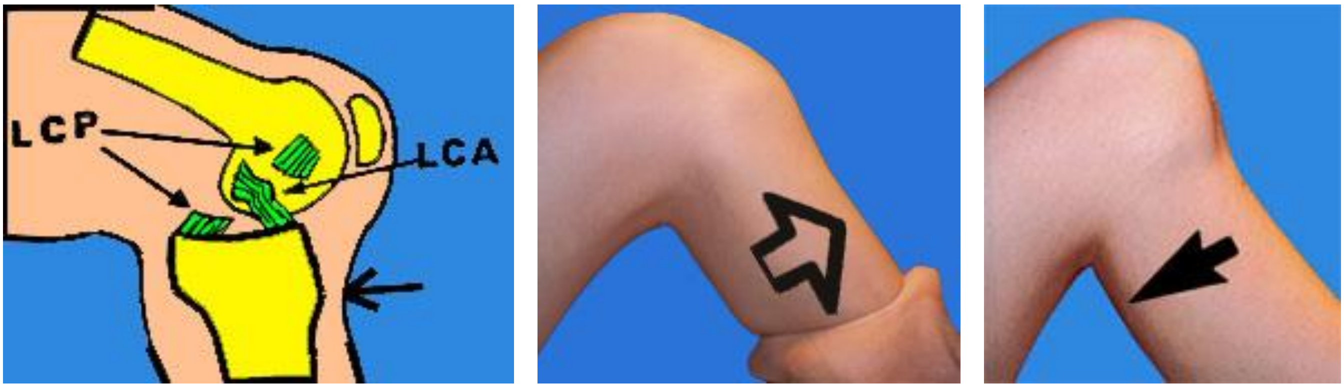
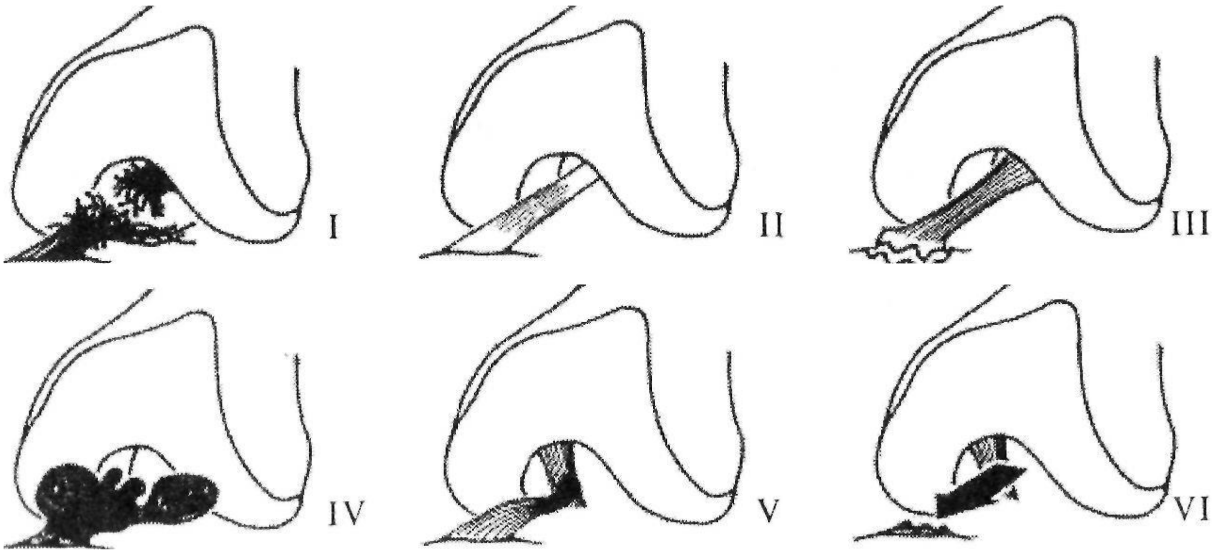


Fig. 39. The "drawer" symptom»

With long-standing ligament ruptures, the "drawer" symptom may become indistinct due to the development of adipose tissue around the rupture site, which partially stabilizes the knee joint. The diagnosis is clarified by X-ray examination and magnetic resonance imaging.

Types of damage (fig. 40).



40. Types of damage to the anterior cruciate ligament: I - a tear along the "mop ends" type, II – an intrasinovial tear, III - a bone separation of the PKS from the tibia, IV - a tear along the length with a club - shaped thickening and shortening of the fibers of the distal stump of the PKS, V - a proximal tear or separation from the femur, the stump is fixed to the posterior cruciate ligament, VI-a damage to the PKS, in which the ligament fibers completely Gachter A., 1992)

Treatment.

In the acute period, a puncture of the knee joint is performed to remove blood from the joint cavity, a plaster cast is applied to the leg. The leg is slightly bent at the knee joint.

The duration of immobilization is up to one month. Then the cast is removed and physical therapy, massage and physiotherapy are prescribed.

Until about the 60s of the last century, a conservative approach to the treatment of anterior cruciate ligament injuries prevailed. Further studies have shown the inconsistency of such treatment tactics and the advantages of early surgical treatment in recent cases of complete ruptures of the PCC and in cases of already developed chronic joint instability.

Indications for conservative treatment are:

* fresh incomplete damage to one of the PKS beams in the absence of instability. In these cases-treatment using joint fixation followed by active rehabilitation treatment;

* long-standing rupture of the PCC in persons of moderate physical activity with undetected instability. In these cases, active physical therapy is used, aimed at strengthening the muscle component of the limb.

* refusal of patients from surgical intervention.

Indications for operational recovery of the PCC:

* the presence of clinically pronounced joint instability and related complaints in the patient;

* a fresh rupture of one of the PKS bundles in persons of the active physical group (athletes, ballet dancers) is

not advisable:

* performing surgical restoration of the PKS against the background of severe deforming arthrosis (3-4 stages according to Kosinskaya);

* surgical repair of damage to one of the bundles of the PKS in patients who have low physical activity and requirements for the stability of the knee joint.

Types of operations.

If there is a detached fracture of the bone fragment and there is its displacement, an urgent surgical intervention is performed. The bone fragment is fixed to the bone (Fig. 41).

41. Tear-off fracture of the place of attachment of the PCC: a-ZD tomography; b-fixation with a wire.

Arthroscopic resection of the anterior cruciate ligament stump.

Only a part of the damaged ligament undergoes resection with its incomplete rupture, which has the appearance of a long stump. When moving such a long stump into the joint cavity, patients may experience a" blockage " of the joint with a pronounced pain syndrome. Such an operation is performed in cases where the clinical manifestations of instability are absent or minimal in patients with little physical activity.

Open suturing of a fresh detachment of the PCC to the place of attachment to the tibia (fig. 42, a), or the femur (fig. 42, b).

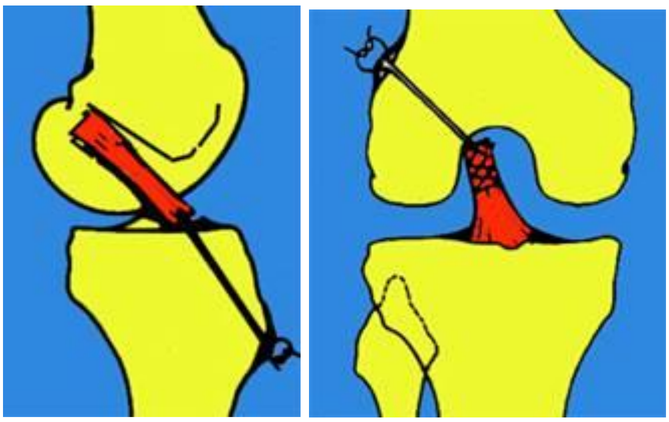


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Fig. 42. Hemming of the fresh separation of the PCC.

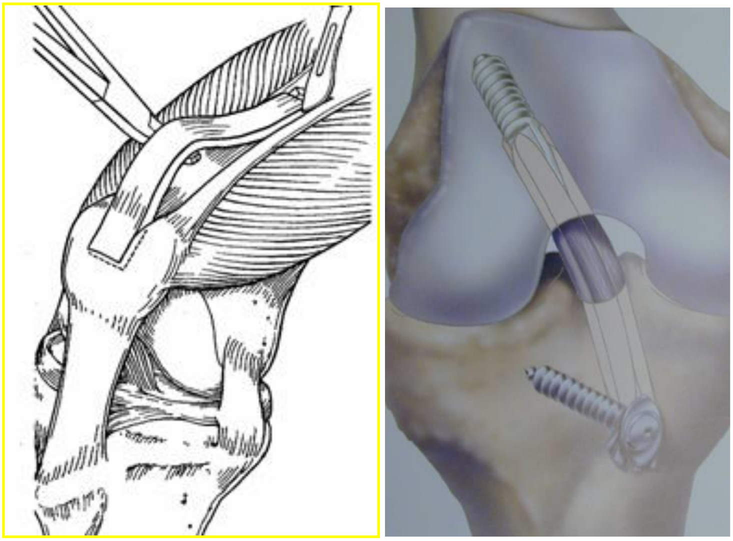
PKS alloplasty.

The use of allosuchinous tissue has shown a number of its valuable advantages. This is a natural origin and low antigenic properties that ensure good engraftability and further restructuring; the absence of additional trauma associated with graft collection and the inevitable weakening of one of the local ligamentous tendon structures selected as a donor;

variability in size and structure; sufficient mechanical strength; convenience and ease of storage (Fig. 43)

43. Allosuchin graft.

Autoplasty of the PCC (fig. 44).



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44. PKS autoplasty: a-quadriceps tendon graft with patellar bone block; b-graft fixation.

Plastic surgery of the PC with a synthetic graft (endoprosthesis) (fig. 45).

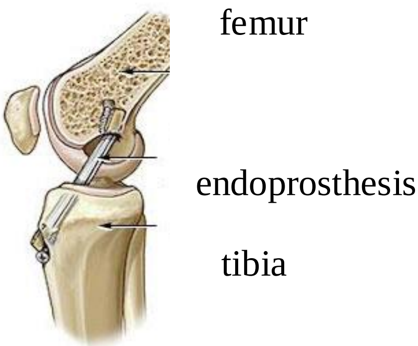


Fig. 45. Plastic surgery of the PC with an endoprosthesis.

The endoscopic method of cruciate ligament repair is the least traumatic. Movements in the joint begin within a few days after the operation, but heavy loads on the joint are not recommended for 1.5 years.

RUPTURES OF THE LATERAL LIGAMENTS:

The external lateral ligament of the knee joint is damaged less often than the internal one, but the entire ligament is more often torn completely (Fig. 46, a) or the ligament is completely torn from the place of its attachment (Fig. 46, b).

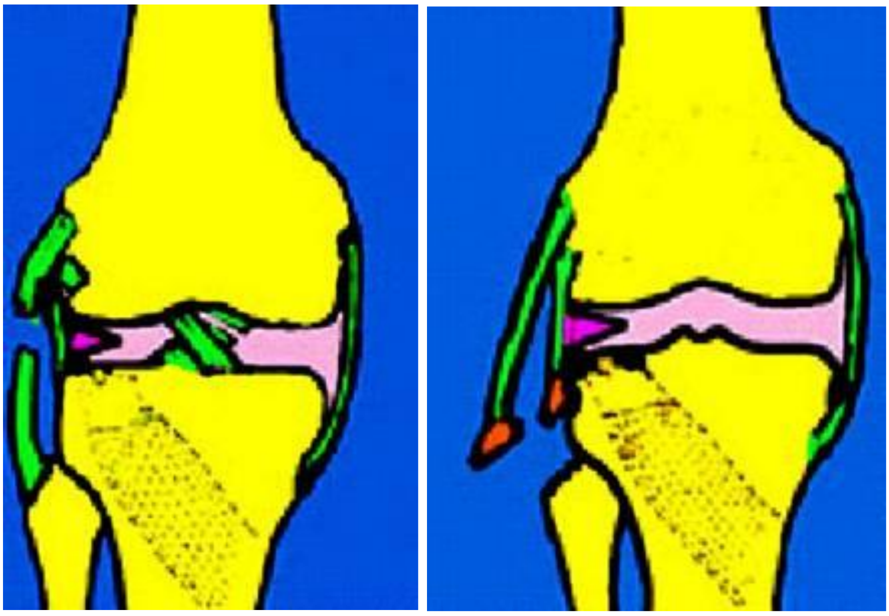
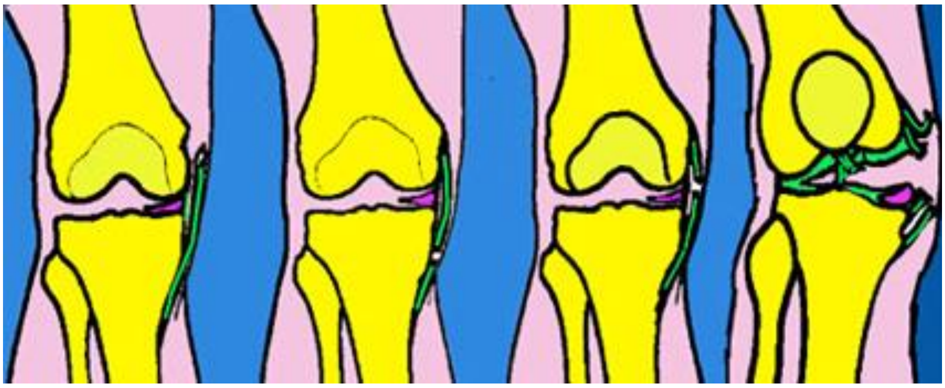


Fig. 46. Ruptures of the external lateral ligament

The internal lateral or collateral tibial ligament undergoes traumatic injuries more often (Fig. 47). However, it usually breaks partially. This ligament starts from the inner condyle of the femur. It has the form of a wide band, covers and strengthens the inner surface of the knee joint, and is attached to the tibia at the bottom. In addition, part of the fibers of the internal lateral ligament is woven into the capsule of the joint and into the tissue of the internal meniscus of the knee joint. This attachment of the ligament leads to possible damage to the internal meniscus of the knee joint with ligament injuries.

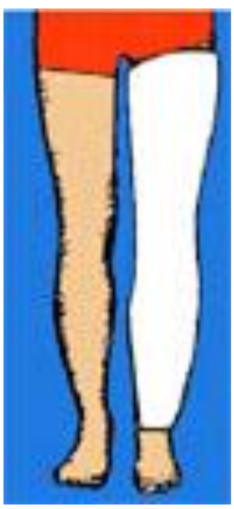


47. Ruptures of the internal lateral ligament.

Damage to the lateral ligaments occurs as a result of tension when the lower leg is deflected. If the lower leg deviates outwards (when walking on an uneven surface, turning the foot on the heel, etc.), the ligaments are subjected to strong tension and are torn or torn. When the lower leg is deflected outwards, the internal ligament is torn, and if the lower leg is deflected inwards, the external lateral ligament of the knee joint is damaged.

Partial ligament tears are manifested by limited flexion in the knee joint, and complete tears lead to excessive mobility (looseness) in the joint. The diagnosis is clarified with the help of X-rays made with special laying of the shins (stress radiography (see Fig. 33).

Symptoms. When the internal lateral ligament is torn, palpation of the medial surface of the knee joint area is painful. The volume of the joint is increased as a result of the accumulation of blood in it and reactive effusion. A positive symptom of lateral swing of the lower leg. When one hand presses on the outer surface of the knee joint and the other hand simultaneously withdraws the lower leg, the valgus deformity of the knee joint increases. This is clearly visible on the X-ray image. The inner lateral ligament is intimately soldered to the meniscus. Incomplete tears (tears) of this ligament to the meniscus. This is one of the causes of the so-called chronic traumatic meniscitis.



When the external lateral ligament is torn. When the lower leg is brought into the knee joint, the outer condyles of the femur and tibia diverge – varus deformity. The X-ray shows a wedge-shaped gap in the knee joint.

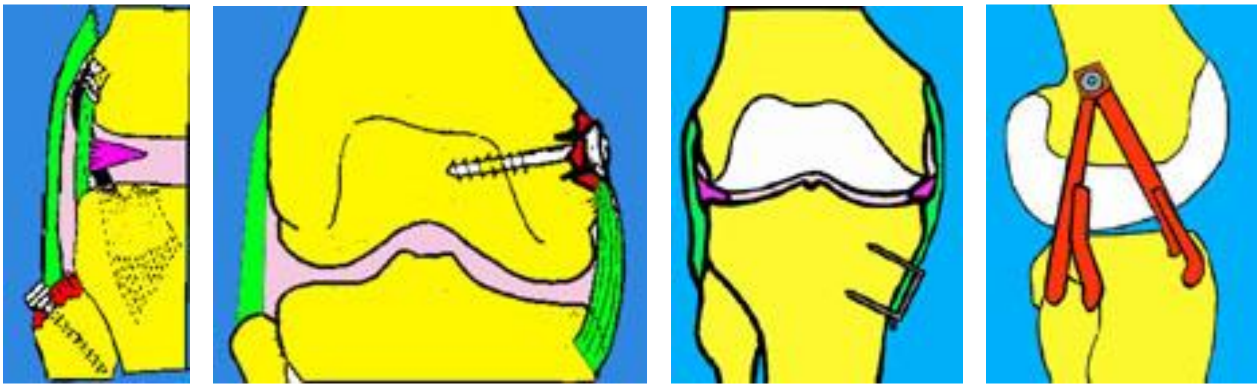
Treatment of damage to the lateral ligaments of the knee joint.

First of all, analgesia of the damage site is performed with a 1% solution of novocaine. If the ligaments are partially torn, a plaster cast is applied to the leg from the upper third of the thigh to the level of the ankles, which is called a "plaster splint" (Fig. 48).

Complete ruptures of the internal lateral ligament, after anesthesia, are also treated conservatively, by applying a plaster cast. A complete rupture of the external lateral ligament requires surgical treatment, which should be carried out in the first days after the traumatic injury. Usually these bundles diverge a considerable distance. They are tightened and sewn with dacron tape. If there is a detached fracture of the tip of the head of the fibula, the fragment is fixed to the fibula with a screw. Sometimes the ligament is not only torn, but also stratified into separate fibers. Then the ligament is reconstructed using grafts.

The results of treatment are not always satisfactory, because the ligaments are fused with a scar and at the same time there is an increase in their length. The lengthening of the ligaments affects the function of the knee joint, which becomes unstable. If this instability is compensated by other structures of the knee joint (cruciate ligament, other parts of the capsule of the knee joint), the function of the knee joint may be satisfactory.

In other cases, it is necessary to resort to surgical treatment-reconstruction of collateral ligaments. Two types of surgical techniques are used: plastic surgery using tendons and grafts to strengthen the ligament, or moving the attachment points of the ligaments.



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49. Operations for injuries of the lateral ligaments: a, b, c-fixation of the places of separation; d-plastic surgery.

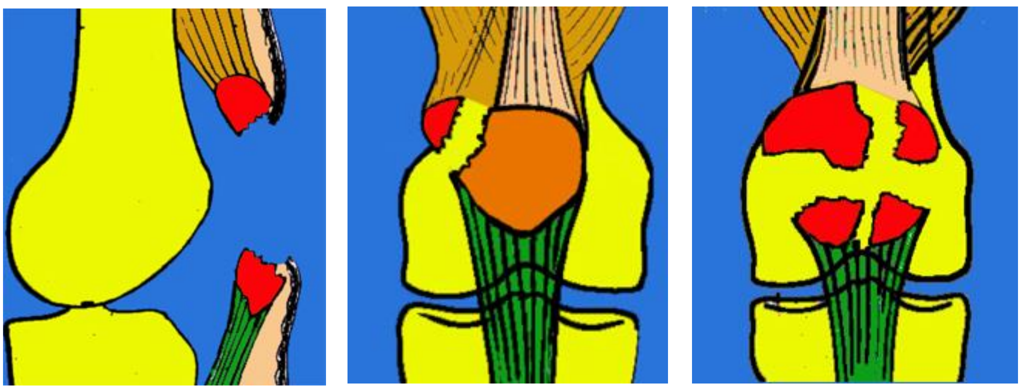
PATELLAR FRACTURES

Biomechanical aspects of patellar fractures

Most often, a patellar fracture is the result of direct exposure to traumatic force. This mechanism is called direct. It is possible when falling on the knee area or when hitting the patella (Fig. 50). The front of the kneecap is poorly protected by soft fabrics. Its posterior surface is almost in close contact with the solid base of the femoral condyles. For these reasons, the destructive force when it is directly applied to the anterior surface of the knee joint mainly falls on the patella (Carpenter J., 1993).

50. Direct mechanism of patellar fracture.

According to V. N. Efimov (1983), transverse and comminuted fractures predominate in direct impact. More often they are fragmented, but at the same time with a small displacement (Fig. 51). As the number of motor vehicles increases, direct trauma increases the number of patellar fractures (Bohler J., 1961). Most often, in road accidents, the knee cup is hit with great force on the panel of the car interior. Thanks to this, the term "Dashboard fracture"appeared in the literature. In this case, the level of the fracture depends on the length of the victim's lower leg and on the height of the panel (Smillie I., 1954).



51. Types of patellar fractures.

Less often, patellar fractures occur as a result of indirect trauma – a sudden sharp contraction of the quadriceps muscle (Rozov V. I., 1933; Kaplan A.V., 1956). The mechanism of its A. DePalma (I954) described as follows: "The quadriceps muscle contracts strongly when transferring the entire weight of the body to the leg, half-bent at the knee, for example, when tripping. The patella at this time is located high on the condyles of the thigh. A sudden contraction of the muscle causes it to break."

52. Forces with three points of application.

The action of the quadriceps femoris is not always the only cause of such fractures. Simultaneously with its strong contraction, with a bent knee joint, there is an emphasis on the middle part of the patella in the condyles of the thigh. The lower and upper edges of it lie on the weight and are stretched at an angle of lig. patellae on one side and the tendon of the quadriceps muscle on the other. Due to the inflection of the kneecap posteriorly, a fracture may occur. This effect can be compared to breaking a stick over the knee.

In the extended knee, the patella transmits almost all the force of the contraction of the quadriceps muscle and, thus, is primarily subjected to stretching. As the knee joint bends, it comes into contact with the femoral condyles, but only a small part of its area. The posterior articular surface of the patella is convex anteriorly. The articular surface of the thigh is convex in the same direction. Thus, the pressure on the surface of the patellofemoral joint in most types of movement has a transversely linear direction (Carpenter J., et al., 1993). The pressure on this area of contact creates forces that have three points of application on the kneecap. Two of them, at its poles, are caused by the traction of the quadriceps muscle and its own ligament; the force vector is directed here from front to back, the third is in the contact zone. The load on it has the opposite direction. Together, all three components act on the bend (Fig. 52).

Most patellar fractures occur as a result of a mixed action of a direct and indirect mechanism. There are 3 components:

* tear-off action of the lower leg extensors;

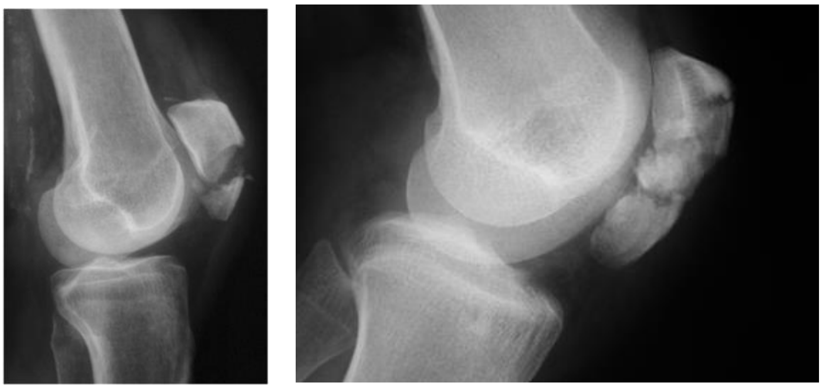
* inflection of the patella through the condyles of the thigh;

* direct blow to the kneecap.

Radiography.

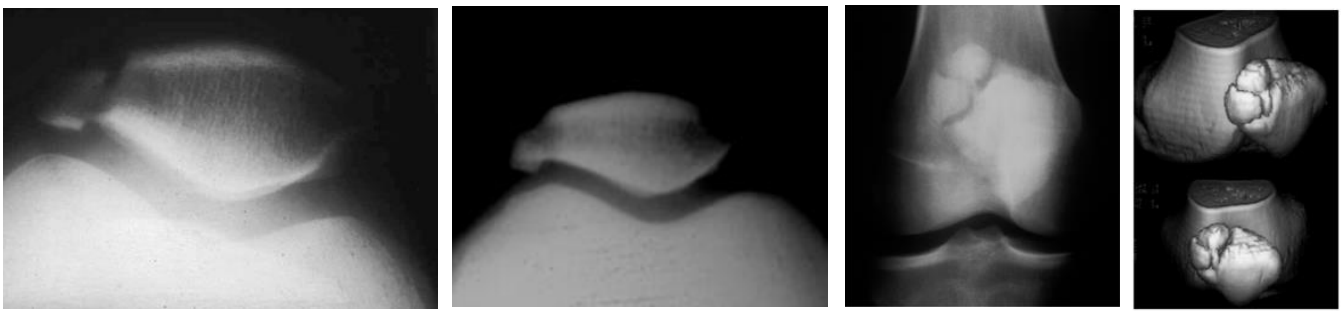
In many cases, the diagnosis of patellar fractures is not difficult due to the visual symptom complex inherent in this type of injury. This largely applies to fractures with a large divergence of fragments, which allowed them to be accurately recognized even before the X-ray examination.

Fractures without displacement, accompanied by a more meager clinical picture, do not cause difficulties due to the timely standard X-ray examination (Fig. 53).



53. Radiographs of patellar fractures.

Along with this, it is necessary to carry out differential diagnostics of longitudinal, marginal fractures with a lobed patella (Fig. 54, b, c, d) and fractures of secondary ossifications. The examination is supplemented with radiography of the opposite side.



a b c d

54. Differential diagnosis:
a-longitudinal fracture; b-patella bipartita; c, d-patella tripartita.

It should be noted that not all fractures are recognized by a standard X-ray examination. The patella is difficult to distinguish on antero-posterior radiographs. Therefore, the picture in a direct projection is performed in the position of the patient on the abdomen, with the rotated lower leg outwards. The beam is centered on the outer edge of the kneecap, which allows you to get a clearer visual image of the patella. If the knee cap appears intact on these radiographs with pronounced clinical symptoms, then there is a need for an additional image in the axial projection according to Zettegast. The patient is placed on his stomach, the injured leg in the knee joint is bent at a right or acute angle. The tape is placed under the knee, and the central beam is directed obliquely at an angle of 45 degrees to the film from the lower pole of the patella. Such images allow in some cases to identify longitudinal fractures (Fig. 54, a, b), which are not visible in normal projections.

Diagnostics.

When making a diagnosis, it is necessary to take into account first of all the complaints of the victim, the mechanism and circumstances of the injury.

Patients usually complain of significant pain in the area of the knee joint, which increases when trying to move.

With a direct blow to the patella with a sufficiently large force, the probability of damage to the articular surfaces of other bones involved in the formation of the knee joint is quite high. It is necessary to take into account the possibility of the patient after the injury to stand on his own injured leg and even more so to walk with the support of it.

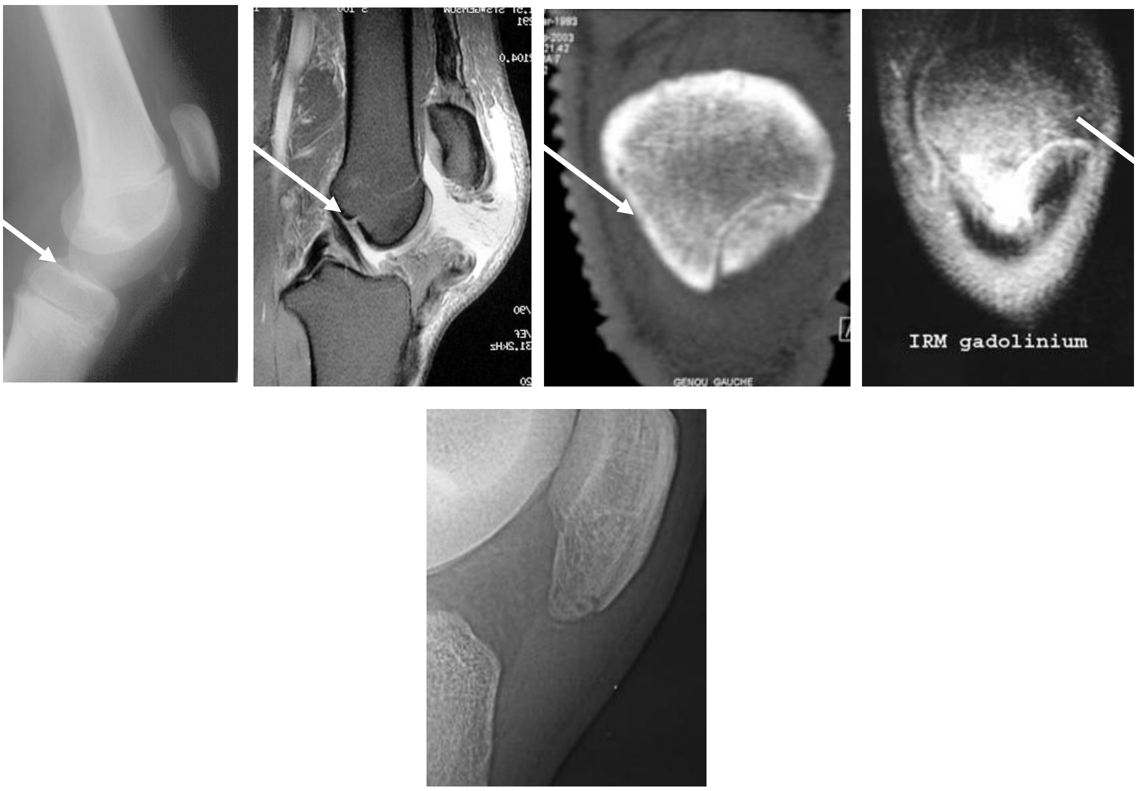
The most common objective sign of a patellar fracture is the smoothness of the contours of the joint due to edema and hemarthrosis, which is more pronounced in the area of the upper inversion. The degree of severity of hemarthrosis directly depends on the severity of the damage. In the absence of displacement of fragments, when the integrity of the extensor apparatus of the lower leg is not violated, blood from the cavity of the knee joint does not spread to the surrounding tissues. Therefore, in these cases, there is no hemorrhage in the subcutaneous tissue, but the balloting of the patella and the fluctuation in the upper inversion are well expressed. On the contrary, the rupture of the capsule and, together with it, the extensor apparatus of the lower leg contribute to hemorrhage in the surrounding tissues with the absence of pronounced symptoms of blood accumulation in the joint.

Passive movements in the knee joint are possible, but sharply painful. When checking their volume, it is necessary to avoid forced flexion of the lower leg, so as not to increase the rupture of the lateral ligamentous apparatus and diastasis between the fragments.

Typical of a dislocated patellar fracture is the patient's inability to lift the extended leg (a positive symptom of a "sliding heel"). This symptom serves as a reason for a more thorough examination of the degree of damage to the lateral extensor apparatus of the knee joint, which largely determines the complex treatment tactics, and sometimes the choice of the method of surgical intervention.

However, it is not always possible to determine the nature of the damaged extensor apparatus. In the first time after the injury (4-7 days), due to local tissue shock, clinical symptoms are often inadequate to pathoanatomical changes. The ability to actively extend the lower leg is restored only by day 7-8.

In this case, an X-ray examination is more objective. The main sign of a rupture of the retaining ligaments of the patella was an increase in diastasis between the fragments on the posterior surface during the flexion of the lower leg or even during the contraction of the quadriceps muscle (Fig. 55).



55. X-ray images and MRI of detached fractures and rupture of the patellar ligament.

Thus, a comparison of all the data obtained on the state of the extensor apparatus of the knee joint, even in the first days after the occurrence of the injury, which helps in solving the issue of the need for surgical intervention in the early stages.

Classification.

All fractures are divided into 4 large groups:

* transverse fractures-there are two fragments with a fracture line running from the lateral to the medial edge, and with the involvement of the articular surface. Depending on the level of the fracture, fractures of the lower, middle and upper third were distinguished.

* comminuted fractures – the fracture forms more than 2 fragments. They, in turn, are divided into fractures with fragmentation of the lower, upper fragments and stellate fractures.

* tear fractures-the separation of a fragment of the upper or lower pole without involving the articular surface.

* longitudinal fractures – the fracture line is located vertically and can pass at the lateral, medial edge or in the middle.

Depending on the size of the divergence of bone fragments, the following degrees of displacement are distinguished:

* Grade I or moderate displacement, when the diastasis formed between the fragments does not exceed 4 mm;

* Grade II, the average displacement at which the bone fragments of the damaged patella diverge by 5-9 mm;

* Grade III or large displacement, when the distance between the fragments is 1 cm or more, and sometimes reaches 6-7 cm.

Indications for surgical treatment.

Surgical treatment of patellar fractures is currently based on three principles of approach •

* restoration of bone anatomy, or osteosynthesis;

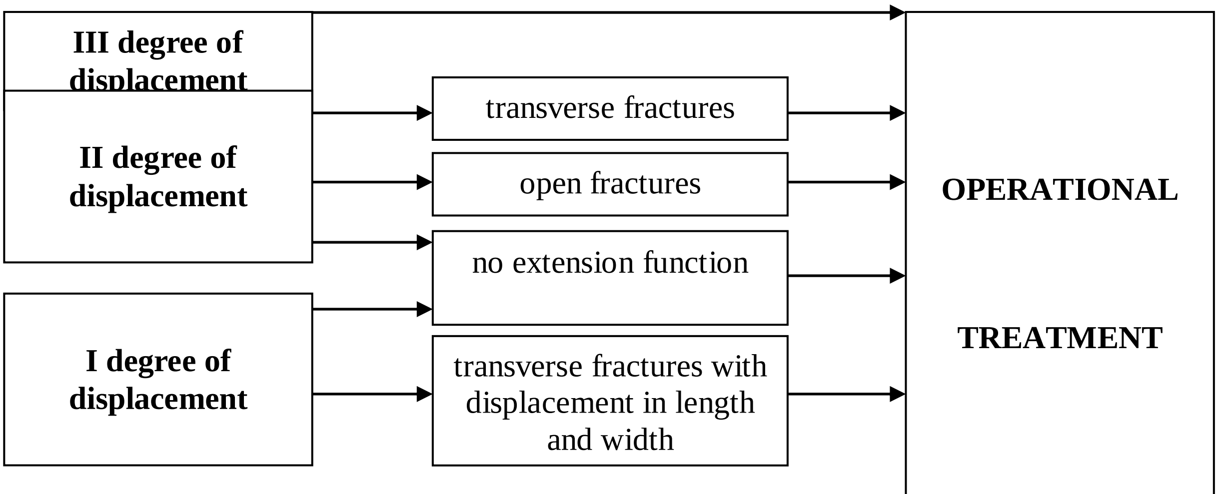
* restoration of the extensor structures of the quadriceps muscle;

* complete or partial removal of the patella.

The question of indications for surgical treatment of patellar fractures is decided on the basis of the nature of local injuries, the general condition of the patient and concomitant diseases. The main factors in the choice of treatment tactics are the degree of displacement of the fragments and, mainly, the rupture of the extensor apparatus of the lower leg.

Patellar fractures with grade I displacement in the vast majority do not require surgical treatment. It is also known that conservative treatment of comminuted fractures of the patella without damage to the extensor apparatus leads to better results than with surgical treatment. This is due to the great difficulty of restoring the congruence of the articular surface in such fractures. Patients with detached fractures are also conservatively supervised, since, being extra-articular, they lead to any significant violations of the function of the knee joint.

All other injuries, including open fractures, are treated promptly. An algorithm of indications for surgical treatment of patellar fractures has been developed (Fig. 56).



56. Algorithm of indications for surgical treatment of patellar fractures.

When choosing a method of surgical treatment, preference is given to restoring the patellar anatomy. If it is impossible to perform osteosynthesis, a part of the patella is removed, followed by the formation of a seam between the left fragment and the tendon-ligamentous elements of the extensor apparatus of the knee joint. The indication for the complete removal of the patella is placed only in exceptional cases, when none of the fragments of the crushed patella can be used as an element of the bone-tendon suture.

Patellar osteosynthesis.

Surgeons still continue to widely use the "old" methods of osteosynthesis, proposed at the end of the 19th century, both in its pure form and in the form of modifications that do not change their essence.

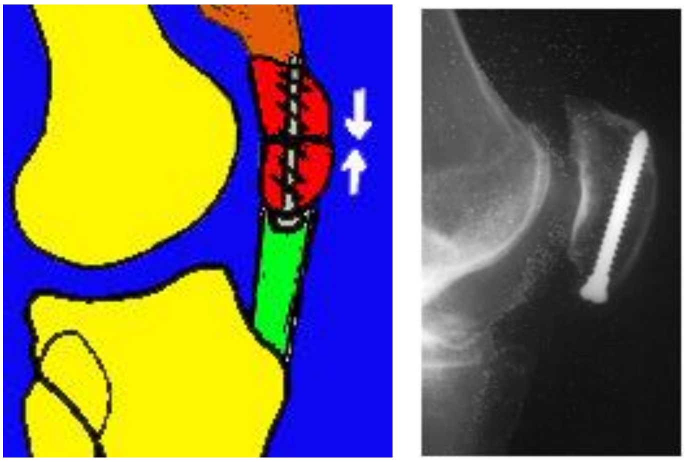
For more than a century, osteosynthesis with a bypass wire (cerclage), proposed by Berger in 1892, or, referred to in foreign literature, the “Denerge Martin's” method (Fig. 57), has been used.

57. Osteosynthesis with a bypass wire according to the Berger method.

As a consequence, Hawley in 1936 used metal wire for a bone suture, passed through the channels and connected on the sides from the patella to a strong joint of the fragments.

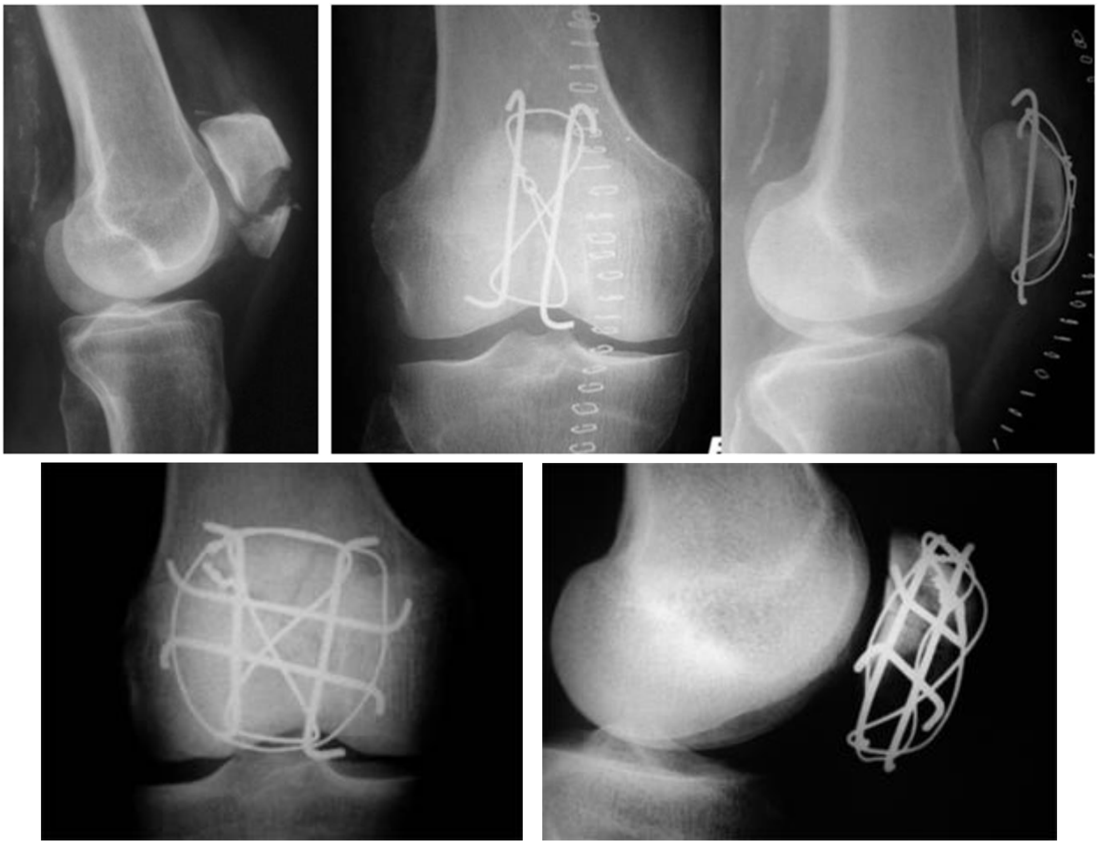
Another, no less popular method is a circular suture with a soft material, the ancestor of which is the operation Shultze (1913), which consists in stitching the lateral extensor apparatus and the prepatellar aponeurosis, followed by the imposition of a peripatellar circular silk suture. This operation has become widespread, has been used for a long time and has been the subject of numerous modifications.

Osteosynthesis with screws is performed according to the method of the Association of Osteosynthesis (AO), Switzerland (Fig. 58). For this purpose, one or more tightening screws with deep cutting in their final part are used.



58. Osteosynthesis with screws according to the AO method.

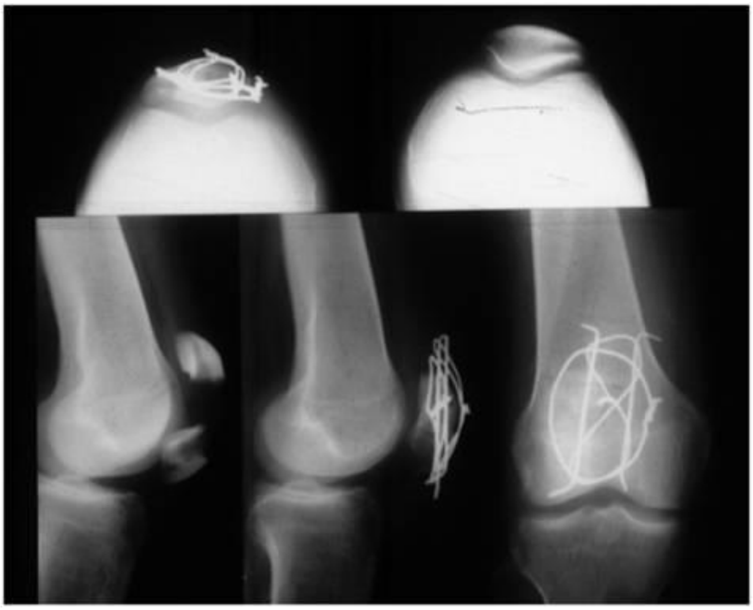
In 1963, Weber proposed the technique of strained osteosynthesis (Zuggertungsosteosynthese), or "tightening loop" osteosynthesis, which is an interconnected spoke-wire system (Figure 59).



59. Osteosynthesis with a tightening loop according to the Weber method.

This ingenious simplicity and unique effect of the ability of the tightening loop to transform the forces of tension into compression forces allows us to solve the main problem that arises in the treatment of intra-articular fractures: the contradiction between the need to immobilize the fracture site-a guarantee of strong bone fusion and, no less important, the need for early movements in the joint, reducing the risk of degenerative changes in it.

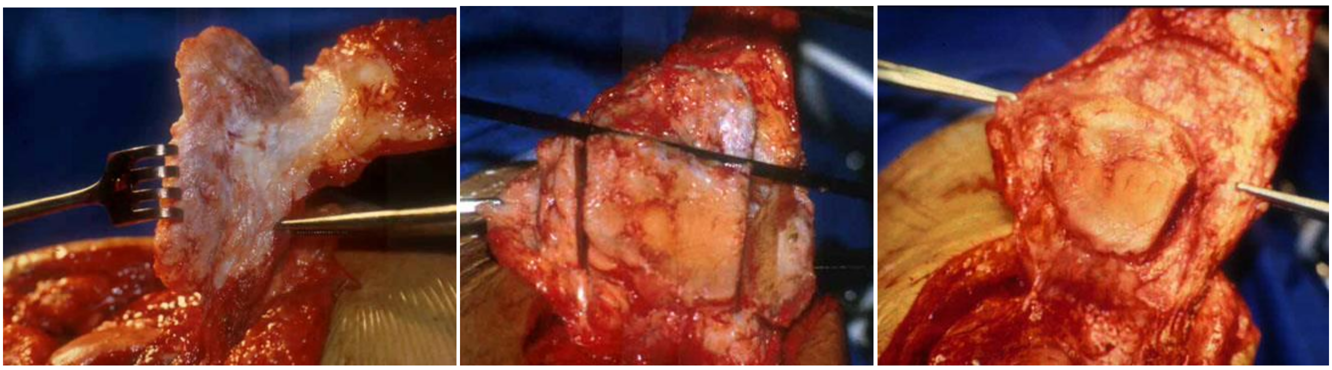
Often, surgeons use a combination of different methods of treatment (fig. 60).

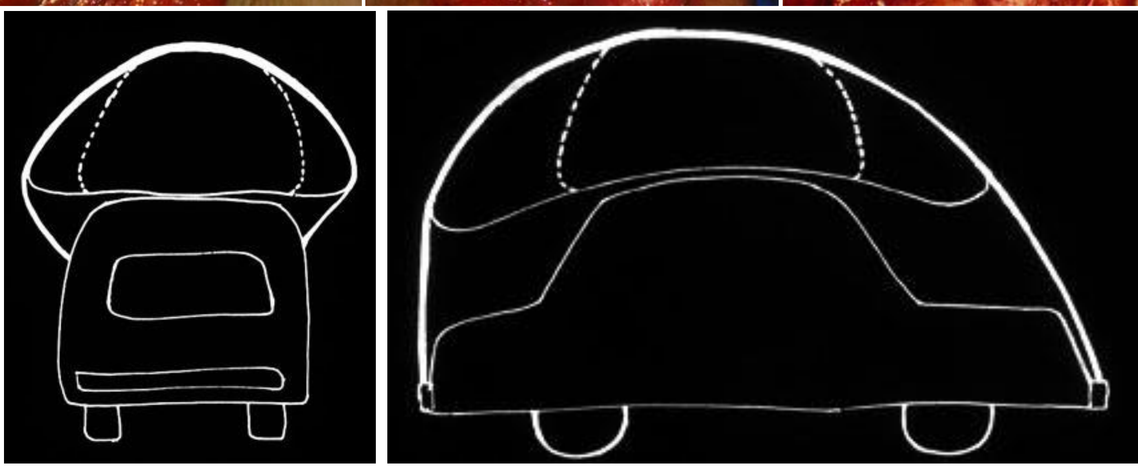


60. Osteosynthesis with a Weber tightening loop and a Berger bypass wire.

Total and partial patellectomy.

For patients with highly fragmented fractures and a large divergence of fragments, as well as the absence of a large fragment with an intact articular surface, the possibility of developing a formidable infection due to the extent of damage and contamination of soft tissues, total patellectomy, despite known limitations, may be the only acceptable method (Carpenter J., et al., 1993). However, it should be remembered that none of the existing methods should be used systematically for all types of fractures. This surgical aid is given a reserve place in the treatment of comminuted fractures of the patella, when there are no conditions for performing osteosynthesis or partial patellectomy.





61. Partial patellectomy or hemipatellectomy.

Partial patellectomy or hemipatellectomy is an intermediate approach between the two preceding ones and is a completely acceptable method of treating fragmented patellar fractures. Due to the preservation of the basic properties of the biomechanics of the knee joint, it is more effective than total.

The only reason for refusing this operation in favor of the latter may be the lack of a sufficiently large fragment that can fully perform the role of a link in the extensor mechanism of the knee joint. A short period of immobilization, a low risk of developing deforming arthrosis and quite acceptable treatment results make partial patellectomy preferable to imperfect osteosynthesis.

Summing up, it should be noted that patellar fractures are a serious injury and their treatment should be approached with great caution. None of the methods should be applied systematically. In each individual case, it is necessary to proceed from specific indications, which, in turn, are determined by the type of fracture, the age of the patient, the anatomical and functional state of the knee joint, as well as concomitant injuries.