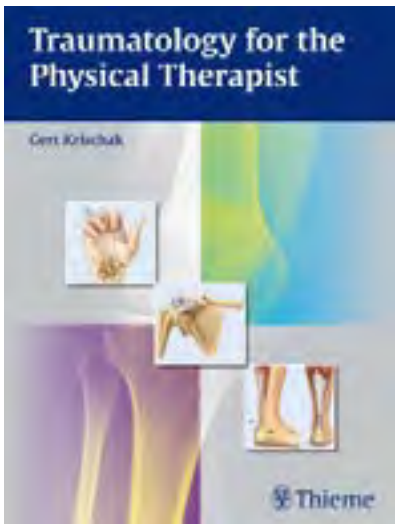
Krischak, G.
Traumatology for the Physical Therapist



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Lateral Ligament Injuries

Clinical Signs

There is pain on pressure over the injured ligament, possibly in combination with effusion or soft tissue swelling.

Diagnosis

The stability is checked in extension and in 30° flexion. Whereas an isolated lateral ligament can be diagnosed by forward give in varus or valgus stress and 30° flexion, there is only forward give in extension when there is a concomitant ACL rupture. Three degrees of instability can be clinical distinguished:

- Single positive (+): give <5°
- Double positive (++): give 5 to 10°
- Triple positive (+++): give >10°

Treatment

Isolated internal and external ligament injuries are now almost always treated conservatively. For 6 weeks, an orthesis is applied that prevents rotation. Surgical reinsertion or suture of interligamentous tears is only indicated in complex ligament injuries. Bony ligament avulsions are usually fixated with an additional plate (**Fig. 16.21**).

Aftercare

In conservative treatment of lateral ligament injuries, ortheses have taken the place of the earlier thigh cast. They permit appropriate knee joint movements (usually from 20 to 60° flexion) with partial load bearing by the leg and thus prevent distinct inactivity atrophy. The reduced weight bearing is maintained for 6 weeks.

After ligament reconstruction, patients may walk only with ground contact for 2 to 4 weeks. As in conservative therapy, a mobility-limiting orthesis (0°–20°–60°) protects the ligament reconstruction from excessive stress by tension. In the fifth and sixth weeks, partial loading with 20 kg is permitted. Complete weight bearing is usually not permitted before 6 weeks. This must be accompanied by an intensive exercise program (e.g., expanded outpatient physical therapy, EOP).

Fig. 16.21 Therapy in complex knee joint instability. The internal ligament was refixed to the bone with a screw and a hook plate (Burri plate) (arrow) and the ligament was also attached with an anchor screw (asterisk).

Knee Joint Dislocation

Knee joint dislocation is the most serious internal knee trauma and usually results from a high-energy impact (**Fig. 16.22**). The trauma causes dislocation of the lower leg, usually in a posterior direction.

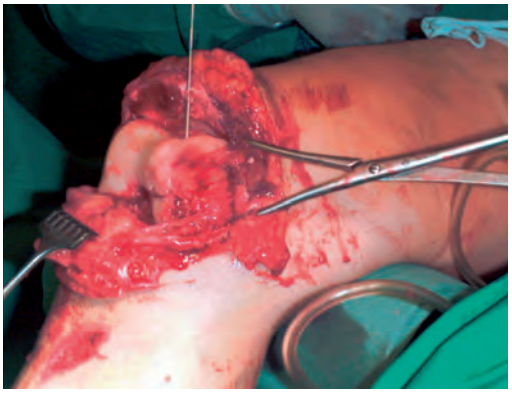

Fig. 16.22 Open knee joint dislocation.

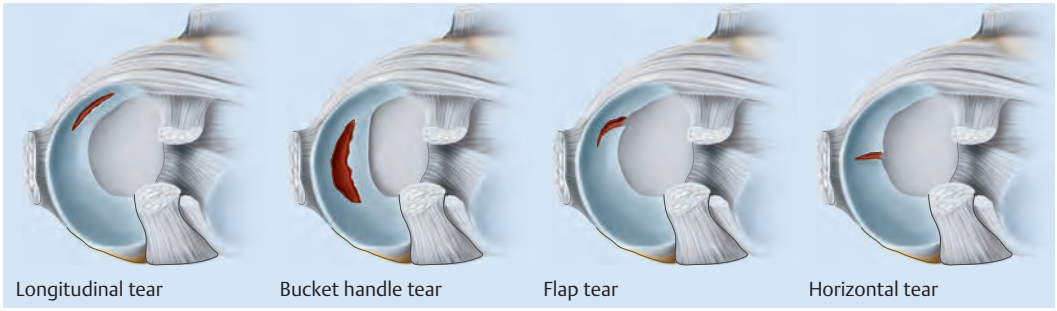

Fig. 16.23 Various forms of meniscus injury.

In addition to extensive injuries of the capsular ligaments, there are also injuries to the popliteal artery in the area of the knee joint. Thus, nerve damage is also common.

Clinical Signs

In addition to checking for obvious malalignment of the knee joint, it is also important to look for signs of ischemia in the lower leg.

Diagnosis

Radiographic examination shows grotesque malalignment of the joint components. In alert patients, motor and sensory function must be thoroughly checked in each case.

Treatment

Because complete dislocation of the knee joint by overextension or vascular lesion leads to insufficient perfusion of the lower leg, repositioning under anesthesia must take place immediately.

After vascular reconstruction, if this is necessary, the capsule and ligaments are reconstructed. If there are other serious associated injuries, an external fixator can be used at first for temporary stabilization, with the definitive reconstruction taking place at a later date.

Aftercare

The type of aftercare is determined by the type and extent of capsular ligament injury, the operative reconstruction achieved, and the associated injuries. These can be very different for each individual case.

Meniscus Injuries

Meniscus injuries almost always occur against a background of prior degenerative damage; only 10% have an exclusively traumatic origin. This can make evaluation problematic in occupational accidents and claims for damages.

Classification

Different types can be distinguished on the basis of the shape of the tear (**Fig. 16.23**):

- Longitudinal tears
- Bucket handle tear
- Flap tear
- Horizontal tear

Because the meniscal fibers run longitudinally, longitudinal tears are common. A bucket handle tear can develop from a longitudinal tear and, when the handle is folded down, the knee can lock. Horizontal and flap tears can fold over and cause the same kind of acute symptoms.

Clinical Signs

In the longer term, patients report inability to extend the knee or the feeling that something is locking in the knee. Typically there is a localized pain in the intra-articular space with effusion and pain with terminal flexion or extension. Sometimes the mobility of the knee joint is painfully limited.

Diagnosis

Clinical Tests

There are numerous tests available for the examination:

- *Steinmann I sign:* Pain on external rotation of the tibia (for internal meniscus injury) or internal

rotation (for external meniscus injury) in 30° flexion
- *Steinmann II sign:* The point of pain travels posteriorly with increasing flexion
- *Böhler sign:* In extension, pain with valgus (external meniscus) or varus (internal meniscus) stress
- *Payr sign:* Pain at the internal meniscus when sitting cross-legged and with additional pressure of knees on the ground
- *Apley sign:* The patient is prone, the knees are flexed 90°. Pain in the intra-articular space on compression and tibial rotation (like Steinmann I).

There are many other tests. The accuracy of the tests depends on the examiner's experience and lies between 30 and 90% (Hipp et al 2002).

Imaging

Meniscal injuries cannot be visualized on radiographs. On the other hand, tears and meniscal degeneration can be visualized with MRI. The value and necessity of MRI when there is a suspicion of meniscal damage is controversial. An advantage is that associated injuries are recognized and that, where the clinical diagnosis is in doubt, imaging can confirm it in many cases. However, this method is expensive and not all meniscal damage is detected.

If clinical examination suggests meniscal damage, arthroscopy is essential. It is diagnostically more accurate than MRI.

Treatment

Because damage to the cartilage increases the more meniscus is stripped off, as much meniscus as possible should be retained.

Meniscus operations can usually be done arthroscopically. If damage cannot be repaired, the meniscus is resected. If possible, only diseased portions of the tissue are removed (partial meniscectomy). If a meniscus must be removed completely (meniscectomy), there is a risk of permanent, rapidly increasing cartilage damage. To prevent this, a meniscal replacement can be performed. The meniscus may be allogenic (from cadaver donors) or autogenic (from the patient's own body) and can be implanted with various surgical techniques.

Suture of the meniscus is particularly successful in traumatically caused longitudinal tears in areas with better blood supply, close to the edge. Currently, there is increasing argument about suture of tears near the inner edge of the meniscus, where the blood supply is less plentiful. A requirement for this procedure is an intact capsular ligament because in cases of instability the sutures have little chance of healing.

Aftercare

After (partial) resection, early functional aftercare is indicated. Partial loading of 20 kg is required for 2 weeks and then full weight bearing is permitted.

After meniscal suture, more restricted motion is indicated. It is particularly necessary to avoid shear forces acting on the meniscus. Mobility is limited to 0°–10°–70° for 4 to 6 weeks, and for the same period only partial loading of 20 kg should be permitted. Isometric muscle strengthening can be started at once.

Prognosis

After any meniscectomy, even if it is only partial, there is a risk of arthritis.

This can burden the patient with painful inflammatory effusions and limitations of motion.

Complications

If nerves or small vessels are caught in a meniscal suture, there can be persistent postoperative pain, possibly with superficial numbness. Infections and deep vein thromboses in the legs can be caused by the arthroscopy.

Patellar Fractures

Patellar fractures are caused either indirectly by sudden, unexpected flexion of the knee joint with contracted quadriceps muscle or by direct trauma. The most common injury is the dashboard injury, in which the knee hits the dashboard in a traffic accident (~30%). Falls onto a flexed knee are also typical.

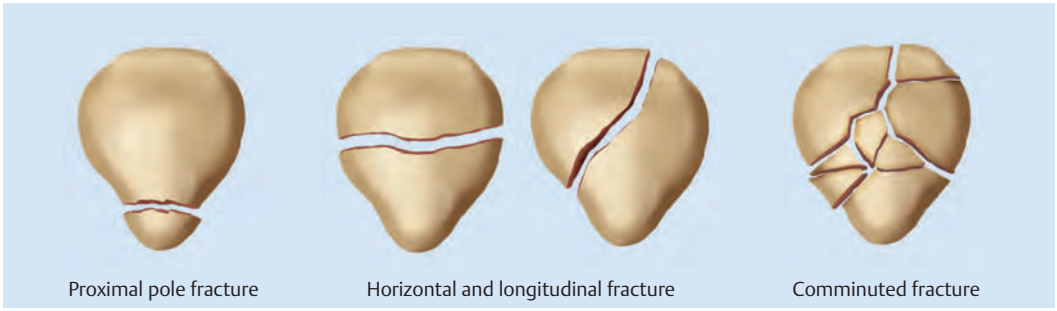

Fig. 16.24 Forms of patellar fracture.

Classification

Three types of patellar fracture can be distinguished: pole fractures (distal or proximal), simple fractures (transverse or longitudinal break), and comminuted fractures (**Fig. 16.24**).

Clinical Signs

There is marked swelling and painful impairment of extension. In dislocated fractures, a space can be palpated.

Diagnosis

Diagnosis is made by radiography.

Treatment

Patellar fracture is a joint fracture. Therefore, the treatment goal is restoration of the articular surface to reduce the risk of posttraumatic arthritis.

Conservative treatment is possible if there is no dislocation and there is little danger of later dislocation of the fragments. Longitudinal fractures are not distracted by the attached muscle pulley system, so they are ideally suited for conservative treatment. This is accompanied with early functional therapy up to the pain threshold with partial loading of 20 kg for 6 weeks. For the first 2 weeks, the flexion should not exceed 90°.

All other fractures are treated operatively. In transverse fractures, fixation is with a tension band (**Fig. 16.25a, b**); in longitudinal fractures, screw

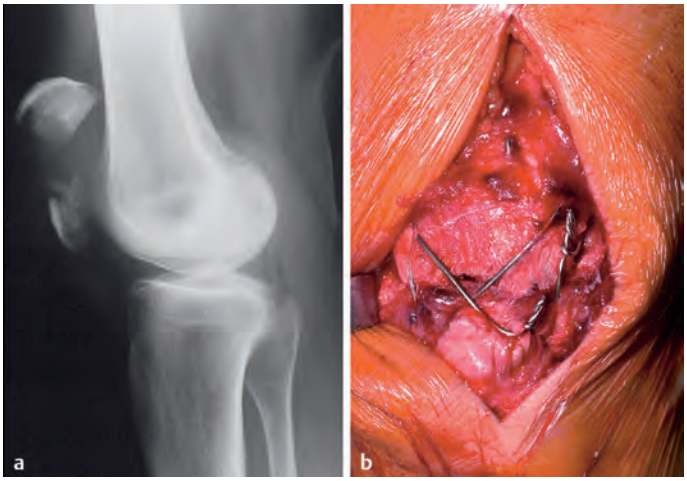

Fig. 16.25a, b Transverse patellar fracture. **a** Radiograph. **b** Intraoperative image of repair with tension banding.

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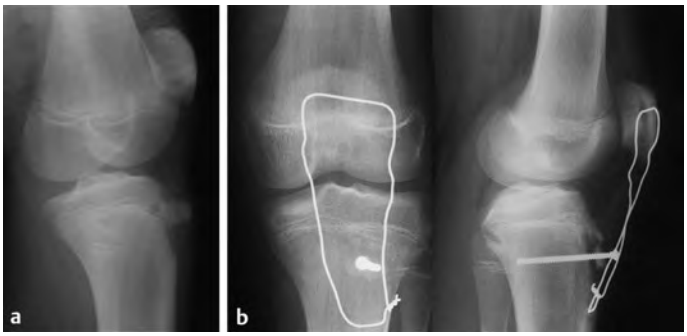

Fig. 16.26a, b Bony patellar tendon avulsion of the tibial tuberosity. **a** Radiograph. **b** Radiograph after reattachment with screw; backup with McLaughlin loop.

fixation can be used. Avulsions at the poles are either reattached or, if appropriate, removed without a significant functional deficit. In multifragmentary fractures, complete removal of the patella (patellectomy) is necessary in rare cases. The extensor tendon is then adapted to the patellar tendon under tension.

If the osteosynthesis is not sufficiently stable or if, in addition, the patellar tendon is avulsed (see Chapter 5, p. 27), an additional wire loop (McLaughlin loop) is inserted between the patella and patellar tendon (**Fig. 16.26a, b**).

Case Study A deaf-mute 13-year-old boy falls in fighting for the ball while playing soccer at recess. He can no longer move his left knee, so the ambulance is called. At the emergency department, a radiograph is taken. It shows a bony avulsion of the patellar tendon attachment to the tibial tuberosity. On the next day, the avulsed tendon is reattached to the tuberosity with a screw and the tension of the tendon is offset with a McLaughlin loop. For 6 weeks, the boy may only bend his leg to a flexion of 60° and he may not bear his full weight. When the loop is removed after 6 weeks, he is no longer required to limit his motion and may bear his full weight.

Aftercare

After operative treatment, the leg should be immobilized for several days until the soft tissue is no longer swollen. Then active and passive movement is permitted. Depending on the fracture, movement is limited in the first 2 to 4 weeks to flexion not exceeding 90°. To avoid adhesions in the articular capsule, the patient is treated with a motorized splint. Isometric strengthening exercises for the quadriceps muscle are permitted from the start; these promote fracture healing. Patients may place a partial load of 20 kg on the affected leg until the fracture is completely consolidated.

Aftercare of the conservatively treated patellar fracture is the same as for operative treatment. However, close radiographic monitoring is required to rule out dislocation.

Case Study A 67-year-old woman trips over a rug while vacuuming at home and falls on her left knee. Because she cannot stand up unaided, her husband calls for an ambulance. At the hospital, a dislocated transverse patellar fracture is diagnosed. The next day, she undergoes operative repositioning and fixation with a tension band. Postoperatively, mobility is limited with a splint. The patient is allowed to load the leg with 20 kg. For 3 weeks she is allowed to flex the knee joint to 30° and for another 2 weeks to 60°; then, until the end of the sixth week, she is allowed to flex to 90° in assistive movements. The load on the leg may only be increased after this point. Five weeks later, free mobility is achieved.

Prognosis

The course of healing is free of complications and, after 6 to 8 weeks, osseous knitting of the fracture is complete.

Complications

If it is not possible to stabilize the fracture sufficiently, muscular tension can prevent fracture healing, with the resulting formation of a nonunion.

Adhesions in the knee capsule or shortening of the muscles can cause mobility disorders (flexion contracture, impairment of extension). This can lead to pain on weight bearing. If the articular surface remains uneven, there is a risk of posttraumatic retropatellar arthritis.

Patellar Dislocation

Patellar dislocation is one of the injuries of knee extension (quadriceps tendon, patella, patellar tendon). In traumatic patellar dislocation, the patella slides laterally out of its track. Medial dislocations are uncommon. Patellar dislocation is promoted by variations in attachment of the patella (osseous malformations of the posterior surface or the femoral groove), by loose connective tissue, by a protruding patella, or by muscular imbalance with preponderance of lateral tension of the thigh musculature. Associated injuries of the lateral stabilizing ligamentous and tendinous apparatus occur, such as shear fractures of the lateral condyle or patellar fractures.

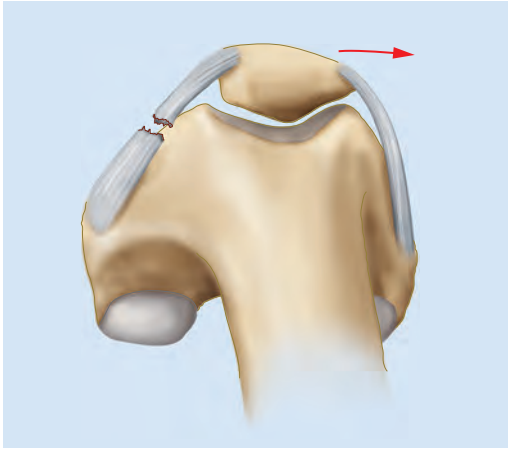

Fig. 16.27 Patellar dislocation in a lateral direction, view from above. Tear of the medial retinaculum.

Classification

In the usual patellar dislocation, the persistently recurring dislocations are typically caused by trivial injuries. A disposition for habitual dislocations is caused by anatomical changes in the patella or the femoral groove.

A difference must be made between these habitual dislocations and traumatic dislocation, which usually results from external rotation injuries. The medial retinaculum is regularly torn. The lack of medial support pulls the patella toward the outside and causes lateral dislocation (**Fig. 16.27**). If the instability persists, dislocations continue to recur; this is called relapsing traumatic patellar dislocation.

Clinical Signs

Immediately after dislocation there is often spontaneous repositioning of the patella. After the first dislocation, there is pain on pressure to the inner side of the patella in the area of the torn medial retinaculum. An articular effusion can often be palpated. The patient prevents the attempt to trigger a dislocation by lateral displacement of the (repositioned) patella by countertension and defensive position. This reaction is a typical apprehension sign.

Habitual dislocation usually causes only short-term pain. The patella is spontaneously repositioned and any articular effusion is only barely palpable.

Diagnosis

Description of the causative accident and the typical symptoms indicate patellar dislocation. Radiographs in two planes can rule out a fracture. A tear of the medial retinaculum can be demonstrated with ultrasound. Where there is a suspicion of habitual dislocation, the geometry of the leg and the muscle relationships must be closely examined. In the radiographic examination (tangential exposure of the patella), anatomical variants of the patella and the femoral groove are diagnosed. The shape of the patella determining predisposition is

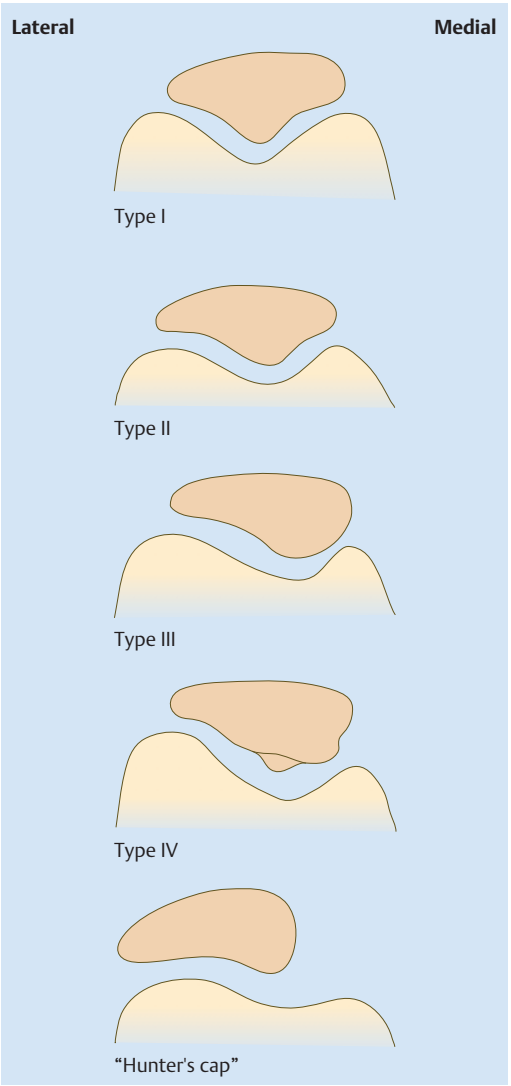

Fig. 16.28 Classification of patellar shapes according to Wiberg and Baumgartl.

described according to Wiberg and Baumgartl (1941) (**Fig. 16.28**):

- **Wiberg Type I:** Medial and lateral facets are of equal size and concave.
- **Wiberg Type II:** Medial facet is considerably smaller than the lateral; concave.
- **Wiberg Type III:** Medial facet is considerably smaller than the lateral; convex.
- **Wiberg Type IV:** There is a small toric, protruding patellar facet.
- A patella with a **missing facet** is called Hunter's cap.

Treatment

After a traumatic first dislocation, treatment usually begins conservatively. This means immobilization in 10° flexion with a cast or orthesis. Physical therapy is intended to prevent a repeat of dislocation.

In habitual or relapsing traumatic dislocation, only operative treatment promises good results. There are almost too many surgical options and techniques for this purpose to enumerate here. A distinction is made between procedures involving soft tissue and bone; where growth is still incomplete, only soft tissue approaches should be used.

The most common procedures can be applied individually or in combination. In soft tissue structures, the lateral retinaculum can be severed (lateral release) or the medial retinaculum can be gathered (**Fig. 16.29a–d**). In the pulley apparatus, procedures to medialize the attachment of the femoral musculature must be distinguished from those in which the distal attachment of the patellar tendon is medialized.

Aftercare

Aftercare depends on the procedure used and can vary greatly. The goal of conservative treatment is strengthening of the medial vastus muscle, which causes the patella to be medialized in its groove. Because of the elevated contact pressure in flexion, exercises in extension are preferable to those in flexion.

Tibial Head Fracture

Tibial head fractures are caused by compression mechanisms or the effect of shear forces. If the femoral condyle is rammed into the tibial plateau, the loose cancellous bone in the tibial head can be significantly compressed. This can cause large deformities in the substance.

Associated injuries to the capsular ligaments of the knee joint and the meniscus are common. Because of the physiological valgus position, the lateral plateau is involved approximately three times more often than the medial plateau.

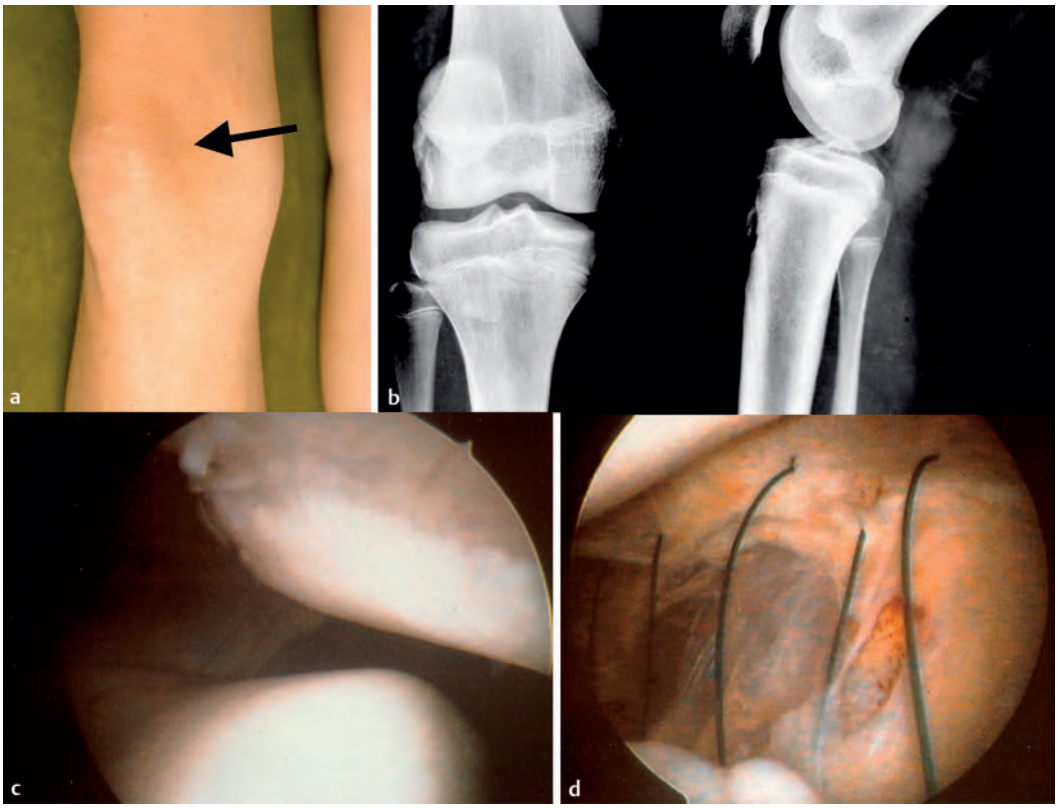

Fig. 16.29a–d Patellar dislocation and treatment. **a** Clinically unambiguous dislocation of the patella in a lateral direction (arrow). **b** Radiograph. **c** Lateralization of the patella in arthroscopy. **d** Arthroscopic suturing of the medial retinaculum.

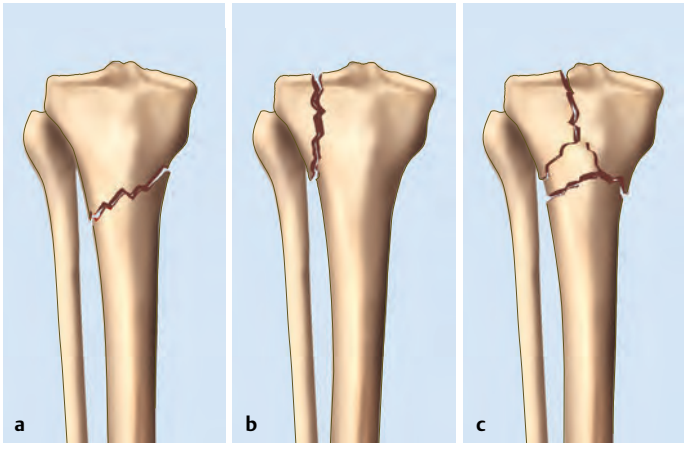

Fig. 16.30 AO classification of tibial head fractures (types A to C).

Classification

A distinction is made between extra-articular (type A) fractures and those that affect either the lateral or medial plateau (type B) or both (type C) (**Fig. 16.30**).

Clinical Signs

Notable signs are pain, swelling, and sometimes a visible deformity of the knee joint. Damage to the peroneal nerve is a possible associated injury.

In both early and late phases, a compartment syndrome may develop (see Chapter 9, p. 58).

Diagnosis

A fracture is diagnosed with radiography. CT is useful for exact evaluation of the articular surfaces and possible areas of deformity. If there is suspicion of damage to the peroneal nerve, additional neurological examinations (e.g., nerve conduction speed) are required.

Treatment

Conservative treatment is possible if there is little or no dislocation without uneven articular surfaces. In all dislocated tibial head fractures, operative treatment is indicated. The first goal of reconstruction is restoration of a smooth articular surface. In deformities of the spongiosa, relining and filling in of defects with autologous cancellous bone (spongiosaplasty) or bone substitutes is often necessary. Stabilization is obtained with spongiosa traction screws, possibly in combination with special support plates (**Fig. 16.31a, b**).

With associated severe soft tissue damage, a joint-bridging external fixator is first applied until definitive treatment is possible.

Aftercare

Until the soft tissue is consolidated, a splint is applied for a few days. After that, type A and type B fractures that have been treated operatively can receive early functional treatment with no weight bearing. In many cases, partial weight bearing at 20 kg is already permitted. The load can be increased from the sixth week; complete weight bearing is permitted after 12 weeks. Significantly longer periods are required for C fractures.

After spongiosaplasty, mechanical stress is permitted only if the freely transplanted bone tissue is revascularized and revitalized. This can usually be expected after 8 to 12 weeks. To ensure sufficient nutrition for the cartilage during this time and to prevent development of capsular adhesions, the knee joint must be provided with passive motion. At first, this is done by the physical therapist; after a few days, a motorized splint may be used. After 2 weeks, a mobility of 0°–0°–90° (extension/flexion) should have been reached.

Complications

The most common complications are deep leg vein thrombosis and compartment syndrome. In addition, because of the thin soft tissue mantle, wound healing disorders and infections are fairly common. Redislocation and implant failure occur in particular in cases of comminuted fractures. Late sequelae are posttraumatic arthritis and knee instability.

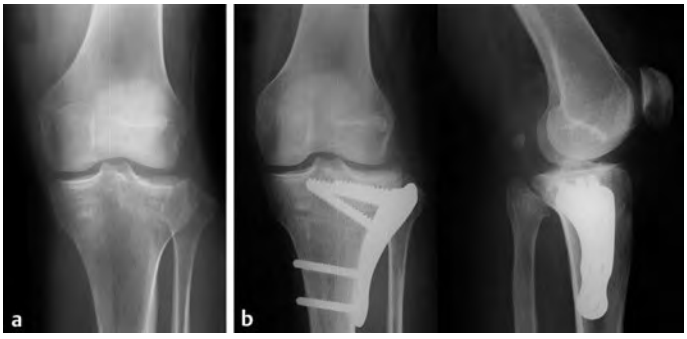

Fig. 16.31a, b Lateral tibial head fracture. **a** Radiograph. **b** Stabilization with angle-stable plate osteosynthesis.

Summary

- Injuries to the knee joint involve mainly ligaments and menisci, often in combination. The "unhappy triad" is typical, in which the ACL, the internal ligament, and the internal meniscus are damaged. Knee joint dislocation is particularly serious, tearing all the internal structures of the knee.
- Ruptures of the cruciate ligaments are typical sport injuries. Medical history and clinical tests permit a certain diagnosis that is often confirmed by modern imaging techniques (MRI). Conservative treatment is possible. However, in active patients, complete ruptures are treated operatively, chiefly with replacement tissues harvested from the patellar tendon or the tendon of the semitendinosus muscle. In principle, the operation should only be performed if the joint is not inflamed, to decrease the risk of movement disorders caused by arthrofibrosis. There are various recommendations for aftercare. The surgeon's instructions are decisive. The prognosis after a successful operation is good, but the risk of progressive arthritis often cannot be avoided.
- Isolated injuries to the lateral ligaments are almost always treated conservatively. An orthesis prevents disadvantageous stresses for a period of 6 weeks and permits limited movement of the knee joint in flexion and extension. In aftercare, physical therapy plays a major role in ensuring a good treatment outcome.
- Knee joint dislocation is chiefly caused by high-energy impact. In addition to injury to the capsular ligaments, there is often damage to the popliteal artery and to nerves. Because of the risk of poor blood supply to the lower leg, repositioning and reconstruction of blood vessels must be done as soon as possible. Additional procedures may be required for the reconstruction of injured capsular ligaments. The type of aftercare is determined by the extent of capsular ligament injury, the surgical reconstruction achieved, and the associated injuries.
- Traumatic meniscus injuries usually occur where the meniscus has previously suffered degenerative damage. Different types of tear are distinguished by their shape. Clinical tests permit diagnosis. Meniscus injuries cannot be detected on radiographs; the value and necessity of MRI are controversial. Arthroscopy permits certain diagnosis and at the same time the necessary treatment, which usually consists of sparing resection and smoothing of edges. The more meniscal tissue is resected, the greater the risk of posttraumatic arthritis. After partial resection, weight bearing can rapidly be resumed. After meniscus suturing, the joint may only bear partial weight for 4 to 6 weeks. Persistent pain after meniscal suturing suggests that small vessels or nerves have been caught in the suture.
- Patellar fracture is a joint fracture. The treatment goal is optimal reconstruction of the articular surface to diminish the risk of posttraumatic arthritis. Therefore, most treatment is operative. If the fracture is not sufficiently stabilized, there is a risk of nonunion. In spite of early functional treatment, adhesions of the knee joint capsule can cause permanent limitation of mobility. In comminuted fractures, the entire patella is sometimes removed (patellectomy).
- Patellar dislocation is promoted by patellar deformities or deformities of the femoral groove (habitual patellar dislocation). The direction of dislocation is almost always lateral. In lateral traumatic patellar dislocation, the medial retinaculum tears. Nevertheless, there is usually spontaneous repositioning. After a first dislocation, treatment is conservative. Various surgical procedures are available to treat relapsing or habitual dislocation. The goal of aftercare is always to eliminate muscular imbalance and to strengthen the pull of the medial vastus muscle on the patella.
- Tibial head fractures are usually compression fractures with associated injuries of the capsular ligaments and the menisci. Sometimes the peroneal nerve is also affected. Treatment is usually operative. If the bony defect must be filled by spongiosaplasty, the joint may not bear weight for up to 12 weeks but it must be moved.

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