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Proximal tibial fractures in elderly patients

Złamania bliższego końca kości piszczelowej u chorych w wieku podeszłym

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S u m m a r y

Most proximal tibial fractures involve the articular surface and may lead to permanent consequences as limitation in range of movement, pain and intra-articular effusion. The most common cause of fractures in elderly persons is low-energy injury. In osteoporotic bone, even a fall from a standing position or insignificant height may lead to fracture. X-rays and CT-scans are useful in classifying the type of the fracture and assessing its extent, whereas MRI visualizes chondral lesions and potential concomitant meniscal and ligamentous injuries in the knee joint. Non-displaced or minimally displaced fractures should be treated with immobilization alone, while severely displaced fractures require surgical treatment. The purpose of surgical treatment in elderly patients is to reconstruct the articular surface and perform fixation stable enough to make plaster immobilization redundant.

Key words: fracture, proximal tibia, osteoporosis

S t r e s z c z e n i e

Złamania bliższego końca kości piszczelowej, jako złamania stawowe kolana, mogą powodować trwałe następstwa w postaci ograniczenia zakresu ruchu, bólów czy wysięków stawu. U ludzi starszych najczęstszą przyczyną złamania jest uraz niskoenergetyczny. Wystarczy upadek z własnej czy niewielkiej wysokości, co przy często osteoporotycznej kości doprowadza do jej złamania. Badania RTG i CT pozwalają określić typ złamania i stopień uszkodzenia tkanki kostnej. Badanie MRI pozwala ocenić stopień uszkodzenia chrząstki stawowej oraz ewentualnie współistniejące uszkodzenia łąkotek i więzadeł stawu kolanowego. Złamania bez przemieszczenia lub z niewielkim przemieszczeniem powinny być leczone zachowawczo, złamania z dużym przemieszczeniem operacyjnie. Leczenie operacyjne powinno dążyć do anatomicznego odtworzenia powierzchni stawowych i tak stabilnego zespolenia odłamów, aby nie było konieczności unieruchomienia starszego pacjenta w opatrunku gipsowym.

Słowa kluczowe: złamanie, bliższy koniec kości piszczelowej, osteoporoza

INTRODUCTION

Proximal tibial fractures constitute approximately 7% of lower limb fractures. A vast majority includes fractures involving the articular surface, the so-called tibial plateau. The degree of damage of the articular cartilage surface and the bone tissue is crucial for prognosis. In the case of severe damages, the most frequently in the case of severe damages (ie. split-depression fractures), the injury may lead to rapid development of the degenerative disease of the knee joint – gonarthrosis (1, 2). Obviously, the treatment outcome is affected by the knee condition before the accident, previous problems with the menisci, degree of use of the articular cartilage, existing limitation of movement range, and perhaps past surgeries, which are factors worsening the prognosis.

DIAGNOSIS

In elderly people, a fracture (fig. 1) is frequently caused by a fall as a result of a stumble or injury resulted from a fall from a small height, e.g. from a chair, windowsill, table, etc. Small forces are necessary to create a fracture in weak osteoporotic bone.

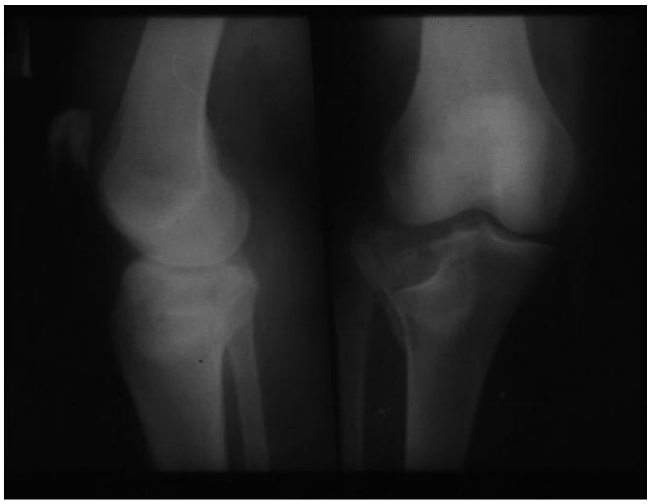

Fig. 1. Split depression fracture of the proximal tibia.

Basic components of the fracture include edema of the knee joint, severe pain at pressure and during movement attempt, and frequently valgus deformation of an axis. Puncture of the knee joint reveals the presence of hematoma and frequently, fat droplets. Basic evaluation consists of X-rays in two projections (fig. 2).

Evaluation includes fracture type, degree of depression and displacement of the bone fragments as well as the bone quality. However, very often an X-ray image is not sufficient in fracture evaluation and it is not able to support a decision on the treatment method. The most useful evaluation method is computed tomography (CT-scan) and magnetic resonance imaging (MRI) (fig. 3). While computed tomography image, especially 3D, perfectly visualizes the degree of bone fragments depression and displacement, the MRI evaluation is irreplaceable in the evaluation of soft tissue damage, mainly the menisci and the ligaments, which may accompany the fracture (fig. 4).

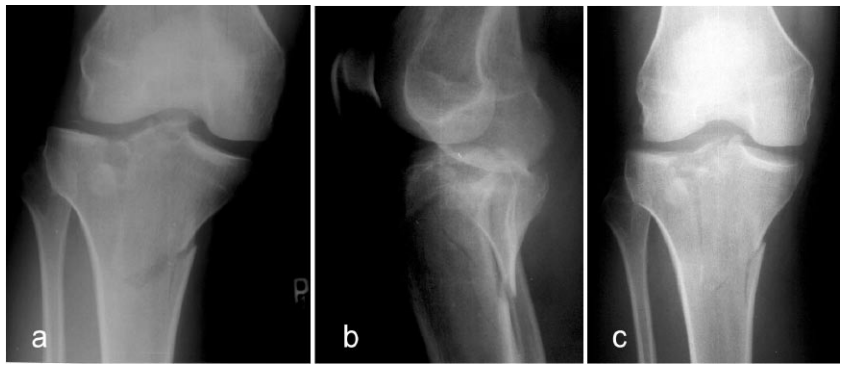

Fig. 2. Type IV fracture according to Schatzker criteria. Figures a and b – initial X-ray. Visible fracture of a large fragment of the medial condyle, including the intercondylar eminence. Figure c – X-ray performed after 4 days of functional treatment with supramalleolar skeletal traction. It seems that the normal position of the bone fragments has been achieved.

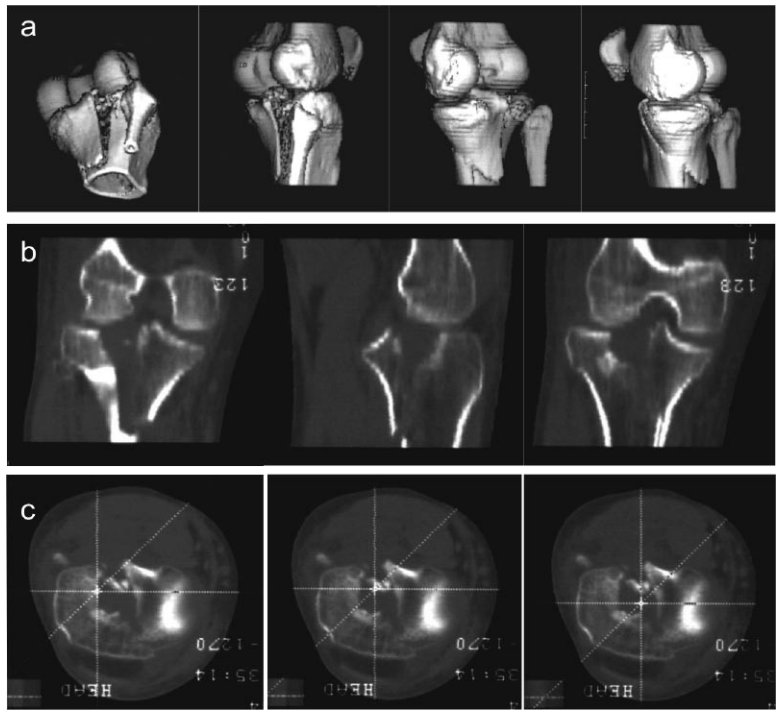

Fig. 3 a, b, c. CT scan of the fracture seen in radiograms in fig. 2. Performed CT-scan showing secondary reconstruction in the frontal and the sagittal planes and 3D images visualize actual, large displacement of the bone fragments in this fracture and 3-cm depression of the articular surface of the medial condyle of the tibia, which significantly changes qualification for treatment method from conservative to surgical therapy.

Fig. 4. X-ray and MRI images of the same knee joint. MRI undoubtedly shows how serious this injury is and it allows performing its detailed evaluation.

One should remember that just as in the case of the spine, elderly people with advanced osteoporosis may suffer from invisible fractures. The patient reports to the doctor pain in the knee joint lasting for some time, and frequently associated with progressing deformity of the limb axis, but the patient does not remember any injury.

PATHOMECHANISM OF THE INJURY

Intra-articular fractures of the proximal tibia occur as a result of not only indirect, but also direct injuries. In elderly patients, there are mainly indirect injuries resulted from a fall on the knee in a slightly valgus position. In general, direct injuries accompany car accidents or result from direct impact on the tibial epiphysis. The important role in the mechanism of fractures is played by the anatomical structure of the femoral and tibial condyles as well as the physiological valgus position of the knee joint. If the force during the injury acts on the lateral surface of the knee joint, the strong and hard femoral condyle crushes and splits the more fragile lateral condyle of the tibia (fig. 5). Damage of the tibial lateral collateral ligament may also occur in such case. If the force comes from the medial direction, the medial femoral condyle, which is also stronger, crushes or splits the more fragile medial condyle of the tibia (fig. 6), and in addition, lateral ligament structures may be damaged. In the case of a fall from a height on an extended limb, the femoral condyles, acting as a ram, may crush and split the tibial condyles (fig. 7). Fracture lines, which are occurring in this case, resemble reversed letters “V”, “T” and “Y”.

Pathomechanism of fracture of the lateral tibial condyle according to Trickey, who was one of the pioneers noticing possible coexistence of injuries of the menisci and ligaments (fig. 8):

a) tears of the tibial collateral ligament and frequent tears of the anterior cruciate ligament usually occur in both types of fractures,
b) in exceptional cases, proximal tibial fractures occur as a result of previous surgical treatment. Godde (3) and Kurt (4) describe fractures after high tibial osteotomies; Stetson (5) describes these fractures after Fulkerson osteotomy (6 cases). Delcogliano (6) and El-Hage (7) describe the cases of fractures after reconstruction of the anterior cruciate ligament.

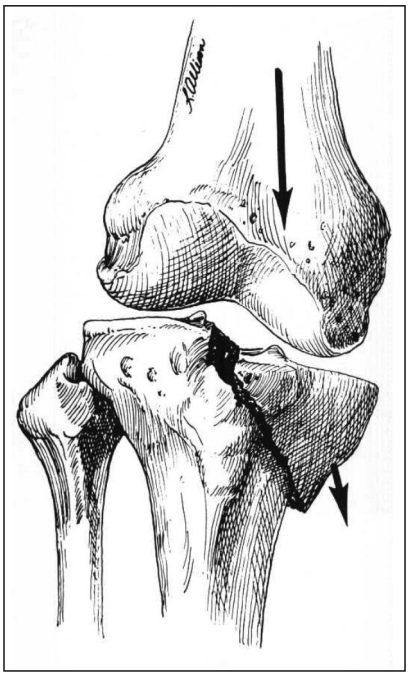

Fig. 5. Injury of the external articular surface, abduction mechanism.

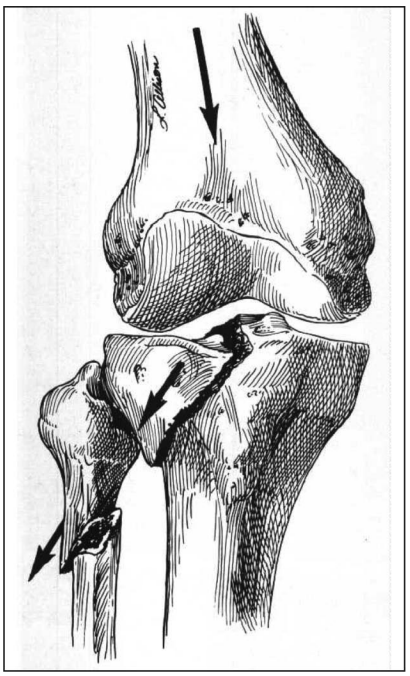

Fig. 6. Injury of the internal articular surface, adduction mechanism.

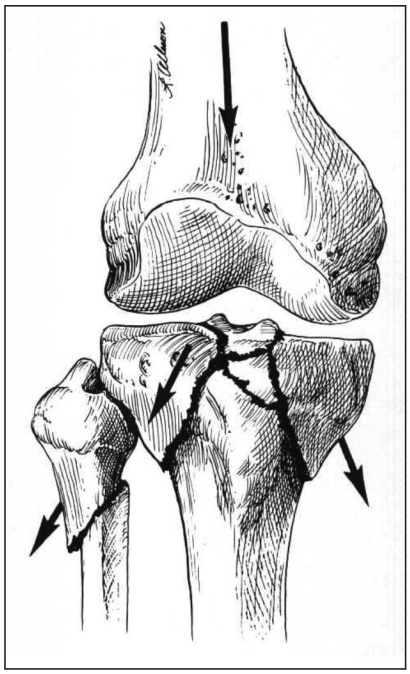

Fig. 7. Injury acting along the limb axis, fall from height.

CLINICAL CLASSIFICATION OF FRACTURES

Fracture classification according to AO ASIF (8)

Fractures involving the articular surface are classified in types B and C:

B – Partial articular fractures (fig. 9),

C – Articular fractures (fig. 10).

Schatzker classification (9) (fig. 11)

The classifications presented are just some of many existing ones. Łukasik, Wejsflog, Kuś, Tylman and Dziak in Poland, and Moore, Khan, Hohl or Honkonen are not all the authors of their own classifications. However, in practice, such untypical fracture lines sometimes occur that it is difficult to define the fracture type, even in the most extensive AO classification, which defines 27 different types of fractures, including their subtypes.

TREATMENT METHODS

Conservative treatment in non-displaced fractures includes immobilization in a long leg plaster cast for a period of 6-8 weeks, and then performing active exercises, and after approximately 12 weeks, starting to walk with full weight bearing by the limb. Functional treatment, although it occurs as a result of constant movement (fig. 12), ensures nutrition of the articular cartilage, protects against contractures and muscular dystrophy, enforces better circulation and metabolite elimination, allows observing the limb; in elderly people it is the most frequently impossible due to extensively long, ca. 6-week immobilization in bed and due to socioeconomic reasons.

In a majority of cases, the principle in management is surgical treatment in order to achieve anatomical reconstruction of the articular surfaces and stable fixation of the bone fragments, which eliminates the necessity to use a plaster cast. Active and passive exercises (Gruca

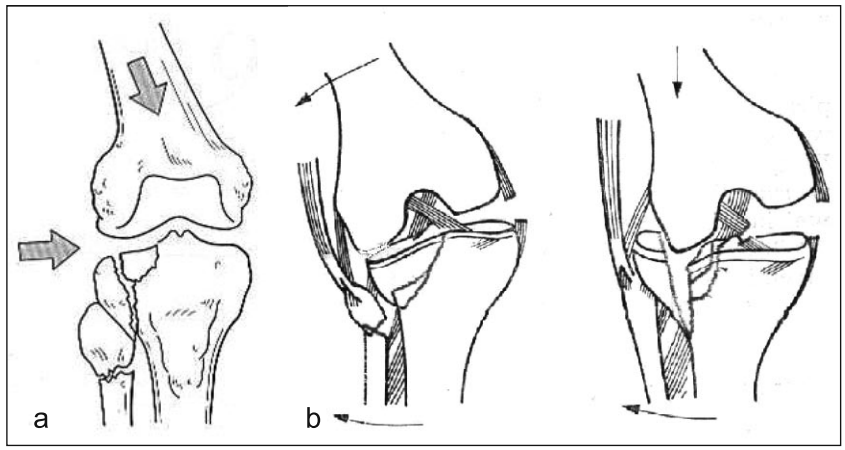

Fig. 8 a – the lateral tibial condyle, which was broken off, is pressed by the lateral femoral condyle, b – the lateral tibial condyle, which was broken off, is moved by the edge of the lateral femoral condyle (18).

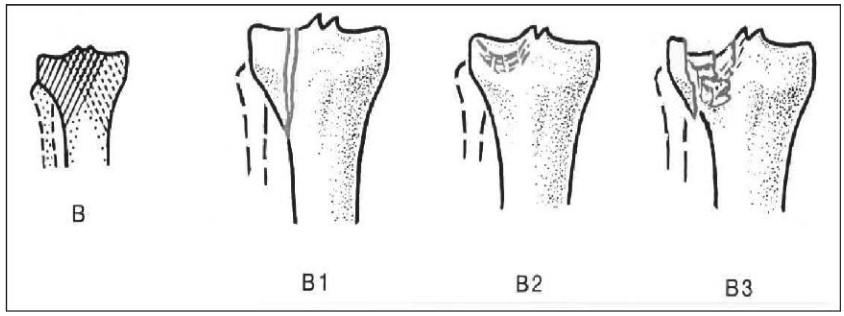

Fig. 9. Classification according to AO/ASIF. Type B fractures.
B1 – split fractures
B2 – depression fractures
B3 – split-depression fractures

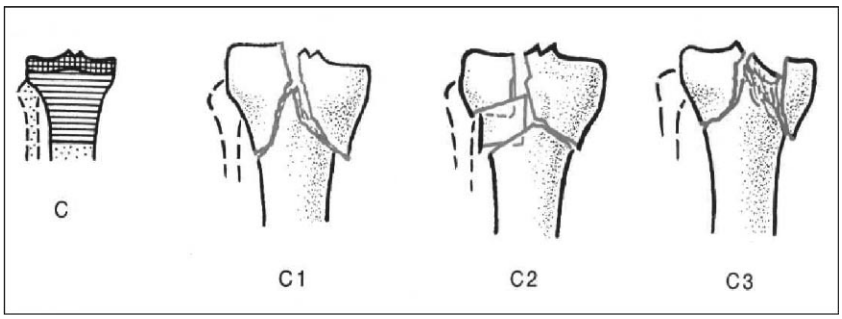

Fig. 10. Classification according to AO/ASIF. Type C fractures.
C1 – simple fracture within epiphysis and metaphysis
C2 – simple fracture within epiphysis, complex fracture within metaphysis
C3 – complex fracture within epiphysis and metaphysic

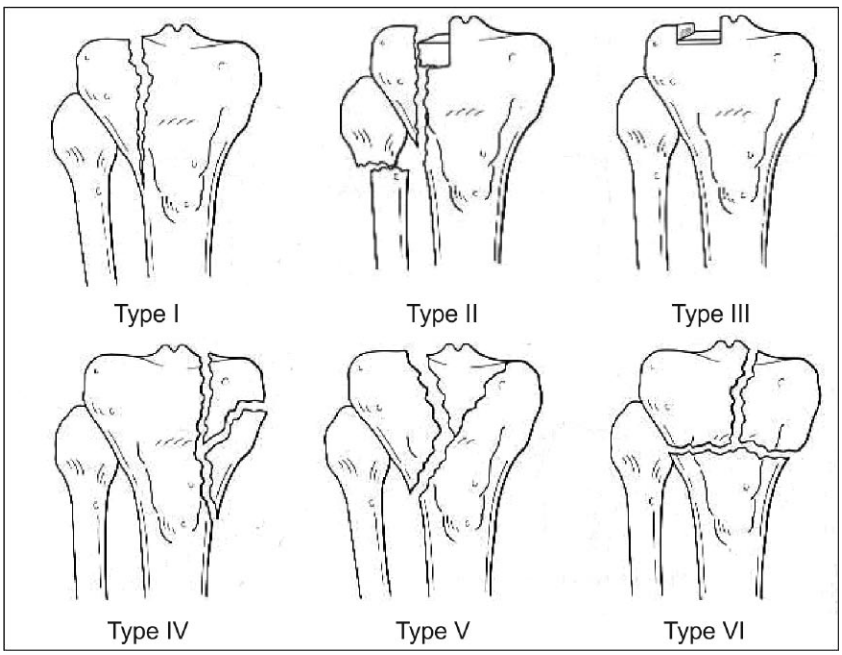

Fig. 11. Schatzker classification:
I. Split fracture.
II. Lateral condyle fracture with depression of the articular surface and wedge-shaped vertical fracture.
III. Fracture with depression in the central part without split.
IV. Medial condyle fracture.
V. Wedge-shaped fracture of both condyles.
VI. Fracture of both condyles with subcondylar fracture, or of the tibial shaft.

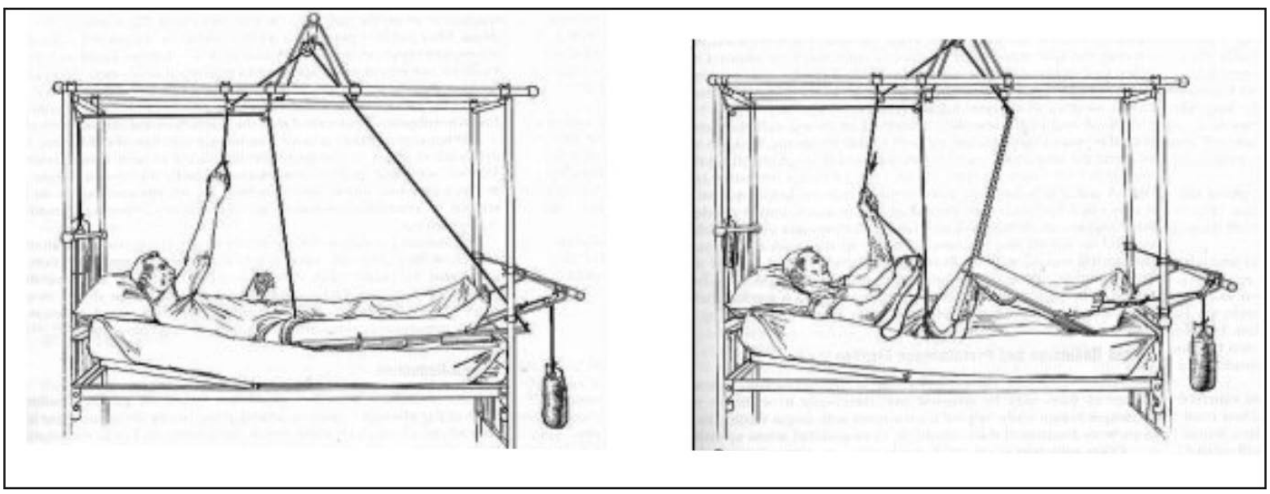

Fig. 12. Functional treatment.

splint, continuous passive motion device) should be implemented from the second day following the surgical procedure, but elimination of weight bearing by the joint, regardless of the treatment method, has to last at least 3 months. In displaced fractures, the key issue is to reconstruct the articular surface, which restores the joint congruence. While lateral displacement in splint fractures sometimes may be eliminated by compression, complete elevation of the depressed articular surface is rarely successful in conservative treatment (direct traction). There is no consensus in reference to the depth of the depression, which would be an absolute indication for surgical treatment. Honkonen (10) is one of a few who clearly defined indications for surgery: depression from 4 mm, displacement from 6 mm, slant of the lateral condyle exceeding 6°, each slant of the medial condyle (slightly valgus position is permissible, any varus position – is not). For Lachiewicz (11), permissible depression is 4 mm, for Bennet (12) 5 mm, and for Schulak (13) even 10 mm. **The necessity of simultaneous surgical treatment of damaged ligaments in elderly patients rarely occurs, because fractures are rarely accompanied by damaged ligaments. In approximately 30% of surgically treated patients, it is necessary to place sutures on the damaged meniscus, usually the lateral one, or remove it.**

Non-displaced fractures are qualified for treatment in a plaster cast. Fractures with a small displacement of the bone fragments or with severe, compression damage of the articular surface, where placement of the bone fragments in an anatomical position is not possible, are qualified for functional treatment with supramalleolar traction. Split-depression fractures and depression fractures are fixed with screws or with a condylar plate after previous elevation of the articular surface and supporting it with implants. Type V and VI fractures according to Schatzker criteria, i.e. epiphyseal-metaphyseal and frequently diaphyseal, are fixed with external devices, under control of the bone fragments and plateau position with a TV display. The arthroscopic technique (14) is rarely used (fig. 13). Fluid forced into the knee joint during arthroscopy goes through the damaged articular capsule or through the fracture fissure, which results in fast increase in pressure within the shin. Consequences of this phenomenon (compression of the vessels, nerves, muscles, compartment syndrome) may be much more severe than the benefits of arthroscopy.

Reports from the last few years emphasize more and more frequent use of bone cement with calcium phosphate – e.g., Norian SRS – as filling for the defects of crushed bone tissue (instead of typically used bone implants) (15). It allows significantly shortening the period when weight bearing is eliminated from the joint. There are also some publications demonstrating primary endoplasty of the knee joint in severe compression fractures (16).

After cutting the fascia with a transverse cut, the meniscotibial ligament is cut. Elevating the meniscus upwards, after hematoma removal, we control a suitable compartment of the joint and evaluate extension of the fracture. Partial or total removal of the meniscus is necessary in rare cases. Most frequently the meniscus is only torn off from the capsular attachment, and its reattachment after reposition and fixation of the fracture is not a problem. Removal of the meniscus accelerates development of degenerative lesions. One should remember to place the catheter into the joint and perform careful suturing of the synovial membrane and the articular capsule. One of the main purposes of the surgical treatment is obtaining stable fixation in order to immediately start the knee joint exercises. Sometimes, however, due to insufficient stability or in case of irresponsible patients, immobilization in a plaster cast is recommended. The period of immobilisation shouldn't exceed 6 weeks.

Figure 14 presents typical operative setup to proximal tibial fracture treatment. Figures 15, 16 and 17 present operative approaches.

Modern fixation methods

In recent years, according to the principles of the Less Invasive Stabilization System (LISS), LCPs (Locked Compression Plate) are more and more frequently used for fixation of the proximal tibial epiphysis (fig. 18 and 19). This technological advance, which includes a strong fixation of the fracture, gives a possibility of subcutaeous insertion of the plate and its percutaneous stabilization with screws using a dedicated guide allows achieving better and better outcomes. (17-19).

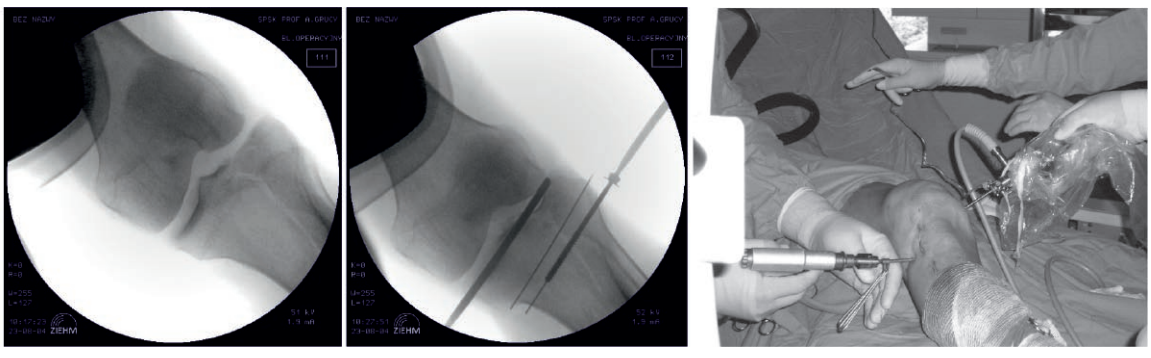

Fig. 13. Split fracture – fixation under arthroscopic control (control of the articular surface of the tibial plateau) and TV display (direction, length of the screws).

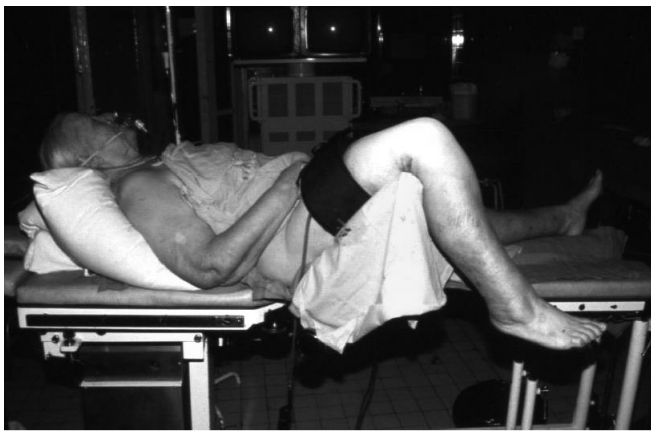

Fig. 14. Patient's position, Esmarck band.

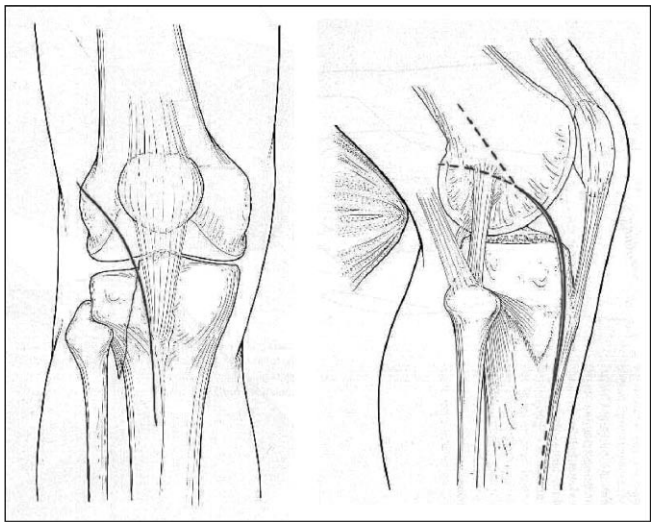

Fig. 15. Anterolateral surgical approach to fracture of the lateral condyle of the tibia.

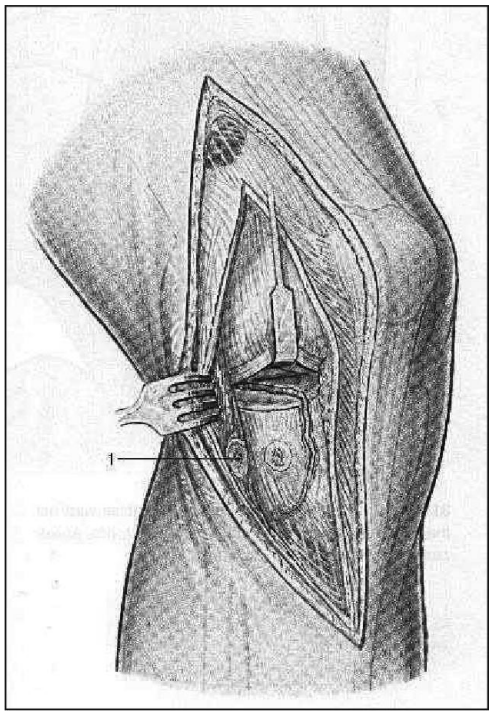

Fig. 16. Schematic illustration of surgical procedure.

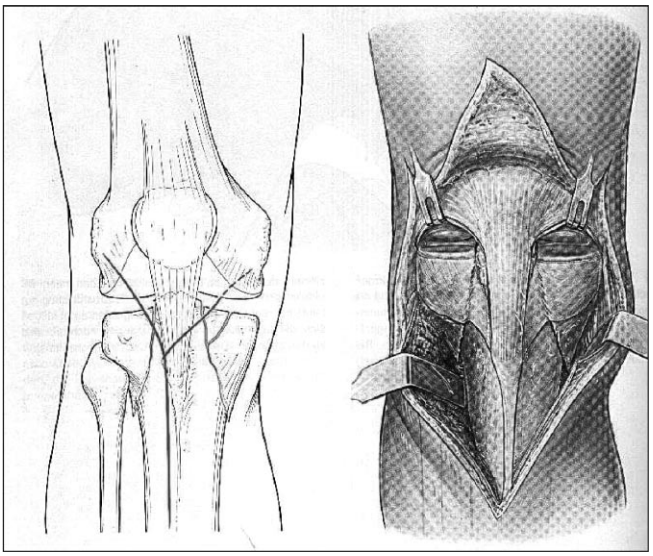

Fig. 17. Surgical access to fracture of both tibial condyles.

Fig. 18. Depression-split fracture. Elevation of the tibial plateau surface, fixation with a T-shaped condylar plate. Surgical access is larger than the previous one, but additional immobilization is not necessary.

Recommended algorithm in management

Conservative treatment

a) Femoral plaster cast:
- Non-displaced fracture (up to 5 mm),
- Patients with general contraindications for surgery,

Fig. 19. Fracture of the proximal tibial epiphysis and metaphysis fixed with a Locking Compression Plate (LCP).

– Patients, who do not provide consent for surgery.

b) Functional treatment:
– Multifragmentary fractures of the proximal epiphysis, metaphysis and tibial shaft only for patients who will tolerate well staying in bed over 6 weeks.

Principles of surgical treatment:
– Anatomical reconstruction of the articular surface,
– Stable fixation,
– Early rehabilitation of the knee joint,
– Long period of weight bearing elimination (over at least 3 months).

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