Fractures of the tibia

Fractures of the proximal tibia

Fractures of the proximal tibia are among the most serious intra-articular fractures with a high number of early and late complications and a dubious prognosis.

- Etiopatogenetically:
  - most often due to axial forces in the limb axis
  - valgus, varus stress especially in the elderly
  - combination

Due to the physiological valgus of the limb axis, due to morphological predispositions in shape and the more subtle spongiosity, fractures are more common on the lateral side than on the medial side. Often, fractures are combined with injury to the ligamentous apparatus of the knee and neurovascular structures.

AO 41 classification

- group A: extraarticular
  - A1 – abruption of the intercondylar eminence
  - A2 – simpe metaphyseal fracture
  - A3 – comminuted metaphyseal fracture

- group B: partially intra-articular
  - B1 – split condyle fracture (avulsion)
  - B2 – impression of the lateral plate
  - B3 – impression and split

- group C: completely articular fratures
  - C1 – articular and metaphyseal simple
  - C2 – articular simple, metaphyseal multifragmentary or comminution
  - C3 – articular multifragmentary or comminution

Segond fracture, AO classification: 41 B1

Classification - according to Tscherne (he modified Moore's original classification of luxation fractures)

I. Rim fractures in ligament injury and luxation of the knee joint (rim avulsion)

1. Segond's fracture - avulsion of the lateral attachment of the joint capsule

2. avulsion of the tuberculum Gerdi (tractus iliotibialis tendon)

3. detachment or impingement of the articular margins of the tibial condyles - possible on both sides

II. Plate fractures (no ligament damage)

1. non-displaced stable fractures

2. fracture of the lateral condyle

3. impression fractures of the lateral condyle

4. lateral condyle fracture with impingement

5. bicondylar fractures

- medial less damaged, lateral may develop significant impression
- the intercondylar eminence remains fixed to one of the fragments, thus no significant instability occurs

III. Luxation fractures - characteristic is the luxation mechanism of origin, most often accompanied by ligamentous and vascular injuries

1. medial condyle avulsion (split fracture)

- the fragment as a whole remains intact and dislocates distally
- characteristic X-ray finding: in the lateral projection, the fracture line runs dorsal to the medial condyle at an angle of about 45° from the centre of the lamina dorsal to the caudal, i.e. the fragment forms the dorsal half of the medial condyle
- neurovaskular injury rare

2. fracture of the entire condyle

- in contrast to a monocondylar fracture of the tibial plateau, the fracture line extends into the contralateral part of the plateau by breaking off part or all of the intercondylar eminence, which either forms a separate fragment or is separated from the fractured condyle, then a lesion of the cruciate ligaments can be assumed
- on the contralateral side, a lesion of the lateral ligament
- on the lateral side, due to distraction, the n. peronaeus communis and popliteal vessels are injured

3. four part fracture (four part fracture)

- the intercondylar eminence is broken away from both condyles and diaphysis (unlike bicondylar tibial plateau fracture), which causes significant instability

Diagnostics

- history, mechanism of injury
- clinical examination
  - mobility, blood flow, peripheral sensation
  - in case of uncertain findings, pulsation or duplex sonography, or acute DSA
  - soft tissue condition
  - if surgery is planned, examination of the ligamentous apparatus under general anaesthesia is advisable
- X-ray:
  - standard projection
  - possibly a plate scan with a central beam inclination of 10° caudally - respecting the physiological reclination of the tibial head
  - possibly two perpendicular oblique projections
- conventional tomography
- CT
- MRI
- arthroscopy:
  - suitable for the diagnosis of lesions of intra-articular structures

Therapy

Rough repositioning is necessary in PP to prevent soft tissue damage. Absolute priority is given to treatment of vascular lesions and decompression of the n. peroneus.

the therapeutic goal

- restoration of joint congruence
- normalisation of axial alignment
- restoring the stability of the ligamentous apparatus
- enabling early mobilisation

conservative management of stable non-displaced fractures

- skeletal traction behind the calcaneus, rehabilitation with a motor splint after two weeks of immobilization in extension

surgical intervention

- unstable or dislocated fractures
- there is a tendency in osteosynthesis technique to move away from extensive open repositioning and splint osteosynthesis towards mini-osteosynthesis and ask-assisted osteosynthesis methods
- monocondilar fractures:
  - repositioning
  - osteosynthesis with cannulated spongiosity screws, possibly with a supporting splint
  - for impression fractures - elevation (by trepanning the cortical bone, we establish access and try to elevate the compressed zone) and spongioplasty
  - fixation of smaller fragments with screws from a small instrumentarium
  - possible arthroscopic revision intra-articular structures

- bicondylar fractures:
  - miniosteosynthesis percutaneously + hybrid ZF (combination of clamp ZF and Ilizarev)
  - bridging ZF (femur - tibia) with later conversion to hybrid ZF
  - Splinting techniques to be indicated with great restraint (Link anatomical splint system)

accessed at

in principle choose longitudinal incisions:

- for bicondylar medial incisions
- in case of involvement of only one part of the flap, medial or lateral parapatellar incision
- Y incisions of the Mercedes type - formerly used, now obsolete and rejected

rehabilitation

- always aim for early rehabilitation
- early motorised walking and walking with relief
- full weight bearing after about 3 months (depending on the type of fracture)

complications

- often these fractures are combined with soft knee injuries
- high risk of compartment syndrome
- injury to the a. poplitea

Fractures of the proximal tibia in children

They are at high risk for acute complications and late sequelae.

1. avulsion of the intercondylar eminence (see soft knee injury)
2. fractures of the proximal tibia
3. epiphyseolysis of the proximal tibia
4. avulsion of the tuberositas tibiae

Fractures of the proximal tibia in children

Rank classifies to:

fractures with risk of arterial bleeding

aetiopathogenetic: traffic accidents, falls from bicycles

- the arteria tibialis anterior penetrates the interosseous membrane at the level of the proximal metaphysis and is firmly fixed there, i.e. vulnerable
- therapy: gross repositioning, provisional fixation and treatment of arterial bleeding

fractures at risk of progressive valgus deformity

the etiopathogenesis is not clearly clarified and there are several hypotheses (medial hyperemia, loss of physiological traction of the rupturedperiosteum, interposition of the periosteum and pes anserinus...)

- spontaneous regression of the angulation, progression and torpid recurrences can occur even after repeated osteotomies
- therapy: exact repositioning of even poorly dislocated fractures is necessary under general anaesthesia under the control of an X-ray intensifier; if the fracture line on the medial side remains open even 2mm on X-ray, surgical revision, removal of the interponate and reconstructive suture of the periosteum is indicated
- repeated corrective osteotomies are often necessary when valgus deformity has developed

Long-term dispensation is always necessary.

Injuries to the proximal epiphysis of the tibia and fibula

anatomical correlate

- secondary ossification nucleus of the proximal tibial epiphysis appears around 2 months, fusion of the common epiphysis and metaphysis occurs between 16-19 years
- the secondary ossification nucleus of the proximal epiphysis of the fibulamanifests around the 3rd year and fuses between 16-19 years
- the internal collateral ligament attaches to the metaphysis, distal to the growth cartilage, the physis is thus protected against valgus violence and therefore injuries to the distal femoral epiphysis are significantly more frequent
- risk of damage to the popliteal artery due to the close anatomical relationship

etiopatogenesis

- Indirect hyperextension or abduction violence is more common in sports and road traffic injuries, as well as direct violence

- part of the abused child syndrome, or perinatal injuries in newborns during complicated births

incidence

- Injury to the proximal growth plate of the tibia is very rare, injury to the proximal growth cartilage of the fibula is quite rare

clinical

- hemarthros, ...

classification

- general
- Salter-Harris

therapy

- hemarthros puncture
- non-dislocated separations of all types are treated conservatively with a 20° flexion plaster bandage for 4-5 weeks
- dislocated separations of type I and II are repaired accurately, valgus and varus angulations are corrected by pulling in the axis of the limb in the semiflexion of the knee (even "innocent" type I and II lyses are associated with the risk of growth disturbance, therefore perfect and gentle repositioning is absolutely necessary)
- hyperextension injuries are repaired first by pulling in slight flexion and then converted to 90° flexion, with direct pressure on the metaphysis from behind, they are repaired and immobilised in this position
- in case of instability, the epiphysis can be percutaneously fixed with two crossed K-wires
- dislocated fractures of type III and IV with significant distraction are better openly repaired and secured by osteosynthesis with tension screws so as not to damage the growing cartilage

complications

- see above
- + late: various types of growth defects, bone bridge (not so often), tibial angulare by hypervascular stimulation, limb avulsion

Avulse tuberositas tibiae

Avulse tuberositas tibiae in a patient with Osgood-Schlatter morbus

anatomy

- the nucleus in the tuberositas tibiae appears around 9 years (earlier in girls) and merges with the main epiphyseal nucleus around 15 years
- avulsion occurs most often in boys between 14 and 16 years of age, when most of the growth cartilage of the tibia has disappeared and only a narrow cartilaginous bridge remains between the nuclei of the epiphysis of the tibia and the tuberosity (it is therefore classified as a transitional fracture, similar to Kleiger's fracture of the distal tibia)

etiopatogenetically

- most commonly sports injuries - athletics, jumping, rebounding, sprinting
- indirectly - by pulling on the ligamentum patellae - either by exaggerated contraction of the quadriceps, or by violent passive knee flexion
- avulse is often in terrain affected by Osgood-Schlatter disease

classification sec. Watson-Jones

1. avulsion of the bone within the range of the ligamentum patellae
2. larger fragment in the proximal direction
3. the fracture line runs from the tip of the tuberosity to the proximal articular surface of the tibia

clinical

- swelling, deformity and tenderness at the attachment site
- mhemarthros may be present
- analgesic posture in the semiflexion with impossible active mobility due to pain

diagnostics

- history, clinic,...
- X-ray – clear findings, bilateral comparison appropriate

therapy

- non-dislocated: conservative - plaster immobilization
- for dislocation: repositioning and osteosynthesis with tension screws, postoperative immobilization for four weeks

note : **m. Osgood-Schlatter**

- osteochondrosis deformans juvenilis tuberositas tibia, (apophysitis, aseptic necrosis of the apophysis, extraarticular osteochondral fracture)
- Chronic overloading leads to dislocation of the cartilaginous part and ossification of this fragment; loose bodies may also form under the lig. patellae
- most often in adolescent boys
- X-ray – fragmentation of the tuberositas tibiae, irregularity of ossification and prominence of the tuberosity
- in contrast to traumatic avulsion:
  - inconspicuous onset
  - intermittent mild discomfort
  - rapid healing, good prognosis
- surgical therapy (extraction of loose bodies) is only considered after closure of the growth plates

Fractures of the diaphysis of the tibia

Fractures of the diaphysis of the **tibia** can occur by indirect (e.g., ski fall) or direct mechanisms (e.g., after a car crashes into the tibia). In the indirect mechanism, the surrounding soft tissues are usually minimally damaged, these injuries are also sometimes referred to as *low-energy injuries*, whereas in the indirect mechanism, open fractures with extensive soft tissue damage are common, thus these are *high-energy injuries*.
The classification of these fractures is based on the assessment of **dislocation** and degree of **comminution**.

Diagnostics

In the diagnostic process, it is very important to correctly assess the mechanism of injury. In low-energy trauma, deformity of the tibia, swelling of the surrounding soft tissues and hematoma may be seen. In high-energy violence, on the other hand, the soft tissues are bruised very significantly, for this reason we must think about the possible development of compartment syndrome, risk of skin cover necrosis and contamination of the open wound.

Therapy

Most of these fractures are indicated for surgical treatment. Closed fractures are often treated with an intramedullary nail, while open fractures are sometimes treated primarily with external fixation because of the risk of infection, and internal osteosynthesis is indicated only after the soft tissues have healed.
Precise repositioning is absolutely essential, as tibial fractures are highly susceptible to complications (subluxation, deformity).

Links

Resources

- PILNÝ, Jaroslav, et al. *Fractures of the diaphyseal bones of the tibia (fracture cruris)* [online]. [cit. 2022-16-12]. <http://www.ortopedie-traumatologie.cz/Zlomeniny-diafyz-kosti-berce-(fraktura-cruris)%20>.

Related articles

- Types of fractures and their dislocations
- Pediatric fractures and epiphyseolysis