lectures & practices
• Internal specialist knows almost everything, but does nothing
• Internal specialist knows almost everything, but does nothing

• Surgeons do almost everything, but know almost nothing
• Internal specialist knows almost everything, but does nothing
• Surgeons do almost everything, but know almost nothing
• Pathologist knows everything and can do everything
• Internal specialist knows almost everything, but does nothing
• Surgeons do almost everything, but know almost nothing
• Pathologist knows everything and can do everything, but in vain…
OUTLINE

• About TRAUMATOLOGY
• Epidemiology
• Theory of bone healing
• Pathology of fractures
• Fracture classification
• Principles of fracture treatment
• Types of conservative and operative fracture treatment
What does it mean to be a trauma surgeon?

Traumatology is an independent speciality in Hungary, Switzerland in Germany, Austria, Slovakia
Trauma & orthopedics services in EU

UK, Denmark, Luxembourg, Holland, Portugal, Sweden

Germany, Switzerland, Austria, Hungary, Slovakia
ETHYMOLOGY

trauma, traumatos

logos

traumatology

orthos

pes /pais

orthopaedics

• injury

• science

• science of injury

• straight

• leg /child

• straight leg(s)/child
Orthopaedics:

Management of injuries and the chronic and hereditary diseases of the musculoskeletal system.

(spine and the extremities)
Traumatology:
treatment of all kinds of injuries
mechanical

thermic  (burn - combustion
freezing - congelation)

chemical
The trauma can be:

unintentional:
  industrial accidents
  road accidents
  household accidents  (the most frequent!)
  sport & leisure accidents

disasters
The trauma can be:

intentional:
  - fights
  - violence, insults
  - wars (inter arma silent musae…)
  - terrorism
Trauma surgeon is experienced

In the management of injuries to the hollow organs

- thorax
- abdomen
Trauma surgeon is experienced:

– Injuries of the central nervous system
– Craniocerebral trauma

Acute Subdural Haematoma (ASDH)
POLYTRAUMA.
EPIDEMIOLOGY

Trauma is the main cause of death & invalidity
1 to 45 years
12% of hospital beds!

- 10 million disabled / year!

- Daily expenses for injuries
  - 265 million dollars! (USA)
HUNGARY:

• ~ 300 million Forint/ day

• ~ 100-120 billion Forint / year
HUNGARY

the mortality rate of accidents:

11.5 /10 000

11 500 deaths / year
MORTALITY STATISTICS:

1. Circulatory
2. Tumorous
3. Trauma /♂:♀=2:1/
Average age of deceased from accidents is ~ 28 years!
(Working age group!)

(In cardiovascular diseases ~ 68 years…)

TRAUMA IS THE „EPIDEMIC” OF OUR TIME
Hip fracture is the most frequent type of injury in elderly

data: USA, Sweden, Hungary

1/3 of beds in Trauma & Orthopedic Departments is occupied by patients with hip fractures!

Treatment costs the government more than the health care of all diabetic patients!
orthopedic-traumatologists use different tools

- scalpel, scissors, pincers
- chisel, hammer, screwdriver,
- drill, grater, saw,
- cutter, pump, motor
- adapter,
- pin, screw, nail, prosthesis
- glue, cement,
- ceramics, metal
orthopedic-traumatologists use the knowledge of

- Anatomist
- carpenter, joiner
- sculptor, bricklayer
- mechanical, smith
- tailor,

- psychiatrist (dignity, spirit, fears, hope, persistence, will power)
THE THEORY OF BONE HEALING

- bone tissue ➔ bone tissue
- Forms of fracture healing (direct/indirect)
- Histology
- Biomechanics
Optimal conditions for bone healing:
- intact soft tissues coverage
- good blood supply of fragments
- spongious bone
- stability between fragments
- good general conditions of the patient

but

healed bone ≠ restoration to health
Forms of bone healing:

Indirect: with callus (spontaneous, natural)

Direct: angiogenous, primary healing
  - without callus
  - contact healing
  - gap healing
DIRECT-CONTACT healing:

connecting bone ends with compression

Very rare in nature, rather artificial
CONTACT HEALING:

Connection: tight and stable!
„DRILLING SHIELD”

face with concrete

osteoclasts

Underground building
DIRECT BONE HEALING II.

GAP HEALING:

between the fractured ends:

No strong contact

Stabil fixation
GAP HEALING

Soft tissue coverage (periosteum) is intact!
INDIRECT (SECONDARY) BONE HEALING: fracture healing with callus formation.

Preconditions:
- appropriate/no fixation
- (controlled) micromovements
- mechanical stimuli /piezo effect?

Negativ pole
↑ Ca ++
Stages of secondary bone healing

1. the early inflammatory stage (a, b) 0-3 w
2. the repair stage (c, d) 4-12 w
3. the late remodelling stage (e) 3 – 18 m
I. Inflammatory phase  
(first few hours and days)

- Bioactive substances  
  - (cytokines, neuropeptids)
- monocytes, macrophages
- neutrophil granulocytes,
- acidosis,
  - hyperemia

  at the fractured site
1. fibroblasts
2. nerve fibres and capillaries

10. day

1-5 days
I. Soft callus: chondrous tissue development

- Precursor cells:
  - fibroblasts → connective tissue
  - chondroblasts → chondrous islands

3-4 weeks
II. Callus mineralisation (1-3 month)  
(The bone ends become joined and stabilized)

Cambium layer ——— bridge (periostal) callus
Chondrous islands ——— endochondral ossif.
Connective tissue ——— endesmal ossif.
SUBSTANCES:

• BMP (Bone Morphogenetic Protein)
• BDGF (Bone Derived Growth Factor)
Bridge callus – cable bridge

6-8 week:
Conservative treatment of humerus fr
III. REMODELLING:

Structural, functional transformation under the forces, applied on the bone, occurs after 3-4 months, to years!.

The bone should be restored to its original shape.
Fracture – healing - remodelling
Conservative treatment of a dog’s femur fr
Quality of the newly formed bone:

The secunder callus is much stronger as the pre-fracture normal bone!
The average bone healing time is: 6-8 weeks

- Strength of bone

![Graph showing bone healing time with different healing processes and time frames.]

Healthy bone

- Spontaneous, indirect healing
- Fracture healing after ORIF
- Direct healing

months

0 2 4 6 8 10 12
THE ROLE OF SURGEON:

treatment options,
proper or wrong applications
The pathology of fractures.

The hard skeleton – bone (solid, elastic)

Fracture: The stress exceeds the limit of flexibility which leads to a change in shape!

Bone resistance:

\[
\text{compression} > \text{bending} > \text{torsion}
\]

\[R_{\text{humerus}}: \]

\[
\begin{align*}
5.000 \text{ N} & \quad 2.000 \text{ N} & \quad 250 \text{ N}
\end{align*}
\]
Displacement of the fractured bones

is induced by the effect of muscles and/or the pull of gravity
Typical displacement types

- **Shortening / lengthening**
  - *(dislocatio ad longitudinem)*

- **rotation** *(dislocatio ad peripheriam)*
- **angulation** *(dislocatio ad axim)*
- **lateral displacement** *(ad latus)*
- **combinations**
Displacement types

- Shortening / lengthening

(dislocatio ad longitudinem)
Displacement types

- Shortening / lengthening
  - (dislocatio ad longitudinem)
- rotation (dislocatio ad peripheriam)
- angulation (dislocatio ad axim)
- lateral displacement (ad latus)
- combinations
angulation and rotation
(dislocatio ad axim et peripheriam)
Displacement types

- Shortening / lengthening
  - (dislocatio ad longitudinem)
- Rotation (dislocatio ad peripheriam)
- Angulation (dislocatio ad axim)
- Lateral displacement (ad latus)
- Combinations
Displacement types

• Combinations
  – Lateral displ.
  – shortening
Fracture classification

• Closed
  – intact skin
  – abrasions
  – décollement
  – compartement syndrome

• Compound (opened)
  – I, II, III/A, III/B, III/C
Stages of the opened fx. Gustillo-Anderson classification

• I. 1 cm or shorter wound with minimal soft tissue stripping, minimal fracture comminutions. The wound is from inside-out.
  – Therapy: as if it was a closed injury
Bone pierced the skin inside out
Stages of the opened fx.
Gustillo-Anderson classification

• II. > 1 cm wound, moderate soft tissue damage, moderate fracture comminutions.
  – After excision, the wound can be closed without stretching the edges!

• Therapy: proper excision & internal fixation
• **III. > 10 cm wound with extensive soft tissue damage**
  
  – **III. A.:** Extensive wound, laceration or flaps, fracture comminuted.
    
    • Primary suture of the wound is impossible!
  
  – Therapy: consider internal fixation or EF
• **III. > 10 cm wound with extensive soft tissue damage (High energy trauma.)**
  
  - **III.B.:** Extensive soft tissue loss, periosteal stripping and exposure of bone, usually associated with massive contamination. Fracture comminuted. **Therapy:** proper wound cleansing and external fixator?
• III. > 10 cm wound with extensive soft tissue damage (High energy trauma.)
Basic principles of the fracture treatment

Original anatomical conditions

Good functional state
Basic principles of fracture treatment
/considering the bone/

**Repositio** (reduction)
Closed, invasive, open

**Retentio** (fixation)
Extension, splinting, plaster, operative fixation

**Rehabilitatio(n)**
gymnastics, physiotherapy, balneotherapy …

Good functional result
Reduction: opposite movements are always necessary!

Closed maneuvers

Invasive or open / operativ maneuvers
Equalization of the angle
Reduction: opposite movements are always necessary!

extension = bone-traction:
Reduction: opposite movements are always necessary!
calcaneus extension
Reduction: opposite movements are always necessary! Olecranon extension!
Be careful!
Crutchfield extension
there is no K wire through the cranium
Principles of fracture treatment II. Retention

- Fracture healing requires relative rest of the fractured ends.

This can be achieved:
- With conservative treatment (operation is not performed)
  - Plaster Of Paris
  - Functional fracture treatment
- Operative fr.treatment, Osteosynthesis
Plaster of Paris

- the joint above and below the fractured bone should be stabilized
- Duration of fracture healing: 4-12 weeks
Functional fracture treatment

• with brace
• not applicable for all fracture types.
Brace on upper arm
Results of fr. treatments:

• Excellent - operative
• Good - conservative
• Fair - conservative
• Poor - operative
OSTEOSYNTHESIS (OS)

- stable OS
- motion stable
- weight bearing stable
- adaptation OS
Tension bending wire

„Minimal”, stable synthesis
„Minimal”, stable synthesis
Wire Pinning

Minimlal OS - adaptation
motion-stable Plate OS
Motion stable – minimal OS FE
FE in veterinary

Fig. 1a. African grey parrot with a type 1 external skeletal fixator. The animal does not appear to be bothered by the fixator. (Photo courtesy Peter Sandmeier)

Fig. 1b. A tie-in external skeletal fixator in an African grey parrot with a proximal oblique femur fracture.
Stable- minimal invasive OSI
IM NAILING
Plate or nail?

Plate osteosynthesis
asymmetric stability
stable fractures → compensated instab.
unstable fractures → decompensated instab.
metal deformity, breakage

Interlocking nailing
symmetric instability
stable fractures compensated instability →
unstable fractures compensated instability +
**Indication**

- **Prox. humerus plate, T plate**
- **L, T mini plate**
- **Scaphoid plate**
- **Mini Hes condylus plate**
- **Clavicula plate**
- **Intramedullary nail**
Tibia condylus supporting plate

Gripper plate

Calcaneus plate

Cobra head plate

Lateral tibial head plate

Tibia condylus supporting plate

Reconstruction plate-curved

L, T supporting plate

DHS

IM sail

Distal tibial plate

Spoon plate, cloverleaf plate, T plate

DHS
Basic principles of fracture treatment /considering the bone/

Repositio (reduction) as soon as possible
Retentio (fixation)  8 weeks +/-
Rehabilitatio(n) 3-9 months

END / Good functional result depends on…
Why should we make OS?

• provide
  • original
    – length of the bone
    – axis of the bone
  • anatomical restoration of articular surfaces
  • early free motion of joints
  • early –partial- bodyweight bearing

• to speed up bone healing ???
• to short time of rehabilitation
• to avoid (reduce) invalidity
How should we operate?

- *Medicus curat, Natura sanat*

- Safe the blood-supply of bone
- Provide biologically sufficient stability
- Protect or restore soft tissue coverage

»Avoid infection!!!