Welcome
INTRODUCTION to
TRAUMATOLOGY

BÉLA TURCHÁNYI
Head of Department of
Traumatology and Hand Surgery
• 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…
lectures & practices
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 • injury
logos • science

traumatology • science of injury

orthos • straight
pes /pais • leg /child

orthopaedics • 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
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.
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
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

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

- psychiatrist (dignity, spirit, fears, hope, persistance, will power)
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 \(\frac{\text{♂}}{\text{♀}} = 2:1\)
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!
Emergency

Traumatology

Orthopedics

Salus aegroti
suprema lex esto
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

Underground building

osteoclasts

living bone  dead bone
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)
2. the repair stage (c, d)
3. the late remodelling stage (e)
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

10.day
I. Soft callus: chondrous tissue develop

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

3-4 weeks
II. Callus mineralisation (1-2 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:
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
Quality of the newly formed bone:
The second callus is much stronger as the pre-fracture normal bone!
The average bone healing time is: 6-8 weeks

- Strength of bone

- Fracture healing after ORIF
  - Direct healing

- Spontaneous, indirect healing

Healthy bone

<table>
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<th>Months</th>
<th>Fracture</th>
<th>Healthy bone</th>
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THE ROLE OF SURGEON:

treatment options, proper or wrong applications
Clinical and physical signs of

• Fractures
  – Pain
  – Deformity (swelling)
  – loss of function
  – abnormal movement
  – crepitation (bone crackling)

• Dislocations
  – Pain
  – deformity
  – loss of function
  – „empty joint”
  – elastic immobility
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!

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

\[R_{\text{humerus}}: \begin{array}{ccc}
5.000 \text{ N} & 2.000 \text{ N} & 250 \text{ N}
\end{array}\]
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
Types of mandible fractures

1. mentum
2. paramedian
3, 4. angulus
5. c. corpus
6. ramus tr.
7. ramus lo.
8. pr. artic.
9. pr. musc.
Types of dental injuries
Luxation and fixation of incisors
Cause of dislocation
plate  plate  plate
Maxillo-mandibular splinting
FE in mandible
Steps of circumferential suture
Le Fort fractures of the maxilla

I.  
II.  
III.
Bleeding! → Suffocation!
complications of maxillary fractures
Maxillo-facial suspension
Wire on screws
Ballon pump reconstruction of sinus maxillaris
Reposition of mandibular dislocation

Do not yawn!
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

• Conservative fixation

• Operative fixation
Plaster of Paris

• the joint above and below the fractured bone should be stabilized

• Duration of fracture treatment: 4-12 weeks
Conservative treatment of humerus fracture.
Conservative treatment of a dog’s femur fr
Functional fracture treatment

• with brace
• not applicable for all fracture types.
Brace on upper arm
OSTEOSYNTHESIS

stable OS

motion stable

weight bearing stable

relatively stable OS

adaptation OS
Results of fr. treatments:

- Excellent - operative
- Good - conservative
- Fair - conservative
- Poor - operative
Tension bending wire
„Minimal“, stable synthesis
Wire Pinning
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.
IM NAILING
Plate or nail?

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

Interlocking nailing
symmetric instability
stable fractures compensated instability –
unstable fractures compensated instability +

rigidity of bolts → rigidity of bolts
bony consol.

6 W
Indication

Prox. humerus plate, T plate

Clavicula plate

Intramedullary nail

Scaphoid plate

L, T mini plate

Mini Hes condylus plate

Prox. humerus plate, T plate

Clavicula plate

Intramedullary nail

Scaphoid plate

L, T mini plate

Mini Hes condylus plate
Cobra head plate

Calcaneus plate

Tibia condylus supporting plate

Gripper plate

Reconstruction plate-curved

Lateral tibial head plate

L, T supporting plate

Spoon plate, cloverleaf plate, T plate

Distal tibial plate

IM nail
Basic principles of fracture treatment /considering the bone/

Repositio (reduction) as soon as possible
Retentio (fixation) 8 weeks +/-
Rehabilititio(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!!!