

Abstract for the 45th International Danube Neurology Symposium, Nov. 20-23, 2013, Prag

Mild Traumatic Brain Injury (TBI)

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The neurological symptoms after an impact to the head are depending on the localization, the direction and the force of the impact. The neuropathological changes are developing from a primary damage at the moment of the impact, mostly followed by secondary factors. For clarification of the severity, the course and the biomechanical principles of the acting force as well as the therapeutic program are of fundamental importance. An acceleration or a deceleration as well as a rotational force transmits energy to the brain, developing a positive pressure on the impact region, the so-called coup region, as well as a negative pressure on the contre coup region and brings shear forces to the inner brain. Lesions at the cortex and in inner brain regions, mostly combined with ruptures of brain vessels, are generated.

With the impact scheme of Spatz, modified by the Innsbruck scheme, six impact positions on the head are to differentiate, after type I to type IV. The impact is hitting the head from frontal, occipital or from lateral, after type V the force is hitting the skull from above, after type VI from below. The force is generating a pressure on the surface of the brain or in the inner brain region. Depending on the lesion an Outer or an Inner Brain Trauma is developing. The severity of a TBI is beside localization and direction depending on the acting force and its intensity. In connection with morphological changes the Mild TBI, the Moderate TBI, the Severe TBI and the severest form of a TBI have to be classified.

According to the EFNS guidelines for Mild Traumatic Brain Injury (2006) in every case of a Head Trauma a neurologist has to be included. The leading symptoms

of Mild TBI are loss of consciousness (LOC) for less than 30 minutes and post traumatic amnesia (PTA) retro- or anterograde with loss of continuous memories for a duration of mostly less than 24 hours. These main symptoms sometimes are accompanied by vegetative disturbances and if the cervical spine has been hit, with headaches. In case of verified cerebral symptoms the change of the classification to a Moderate TBI is necessary. An EEG has to be performed for the final distinction between mild and moderate TBI. In accordance with the guidelines patients with Mild TBI have to be admitted to a hospital. In every case an observation period of 24 hours should be maintained followed by a neurological control. The fundamental treatment of a Mild TBI is bed rest, a minimum period of 3 days is recommended.



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Mild Traumatic Brain Injury

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**27. Czech and Slovak Neurology Congress and
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Traumatic brain injury (TBI)

- is a common reason of morbidity and mortality in European countries
- incidence between 229 and 1.967 for 100.000 inhabitants
- highest incidence in men between 15 and 24 years
- most frequent cause of death for humans under 45 years (most frequent cause of death between age of 20 – 35 years worldwide in the male population)

Different types of TBI

- Closed Brain Trauma
sometimes combined with fracture of skull
- Open Brain Trauma by a penetrating object (bullet, etc.)

Patterns of Brain Trauma

- Outer brain injury
 - Acceleration - Deceleration
- Inner brain injury
- Rotational brain injury

Head Trauma

Impact Scheme modified after Spatz

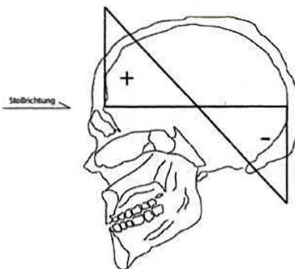
Brain tissue damage depends on
- Direction, form of impact
- Location of impact
- Intensity of the force

Documentation after Spatz,
Innsbruck modified

Multiple impacts possible

Biomechanics of Head Impact

Sellier, Unterharnscheidt, 1963

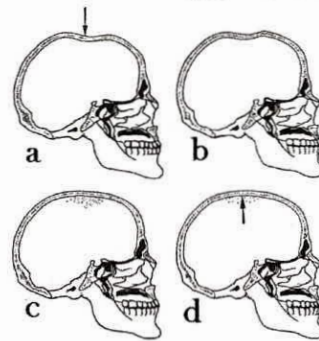


- Positive pressure at the impact pole
- Negative pressure at the counter pole

Different types of head impact

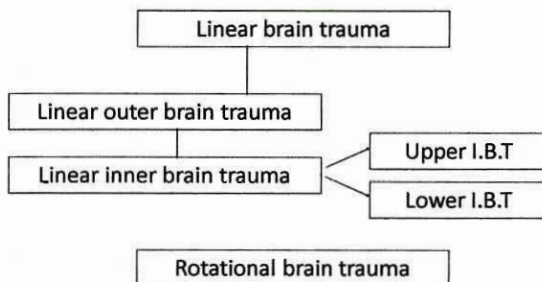
- Translational trauma, local lesions
 - Brain surface
 - Midbrain
- Cavitation trauma, local lesions
 - Impact dependent
 - Periventricular
- Rotational trauma (Pudenz-Shelden)
 - Rupture of brain tissue, brain vessels
 - Inner cerebral
 - Extra cerebral
 - Shear forces

Biomechanics, cavitation trauma after A.G. Gross, 1958



- Lesions to impact region (b): Direct damage due to the impressed skull bone, positive pressure
- Due to snapping back of the elastic skull bone, negative pressure result in gas bubbles (d)

Different Types of Brain Trauma classification by biomechanical analysis



Linear Outer Brain Trauma (Type I, II, III, IV)

- Coup lesions, contre-coup lesions
 - Cortical, subcortical, meningeal damage, crater shaped
- Type I severe lesions fronto-temporal
Contre-coup negative pressure
- Type II minor lesions frontal
force absorption by facial skeleton
- Type III, IV mostly combined with rotational brain trauma

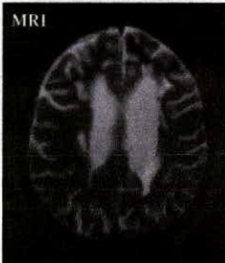
Linear outer Brain Trauma

- Lesions on the surface of the brain, cortical-subcortical meninges (funnel-shaped)

Pathologie



MRI

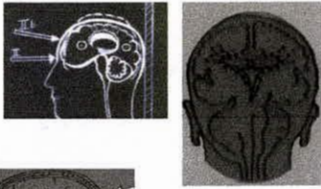


Linear Inner Brain Trauma

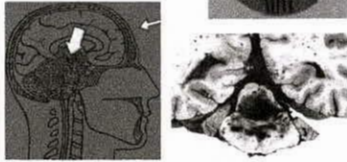
- Inner upper brain trauma (Grcevic)
 - Lesions periventricular (butterfly type): corpus callosum, septum pellucidum, fornix, thalamus, hypothalamus, cingulum
- Inner lower brain trauma (Lindenberg)
 - midbrain-pons lesions (substantia nigra, perirubral zone, crura cerebri, tegmentum, periaqueductal gray, upper pons),
 - surrounding brain regions (perihippocampus, uncus amygdalae, cerebellum)

Linear Inner Brain Trauma

- a) Linear inner upper brain trauma (Grcevic) butterfly lesions Type IIb, Ia (II) cavitation trauma



- b) Linear inner lower brain trauma (Lindenberg) lesions brain stem, surrounding brain region Type V, Va translational trauma



Linear Inner Upper Brain Trauma N. Grcevic



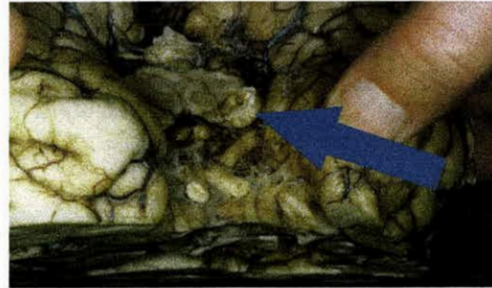
Impact type IIb, Ia, (II)
Main lesions, periventricular
Partly lesions hippocampal area, frontal

Linear Inner Upper Brain Trauma Type Ib



Frontal white matter, periventricular damage

Linear Inner Lower Brain Trauma (Type Va) Combination with Rotational Trauma (IVa) Uncal Tentorial Herniation



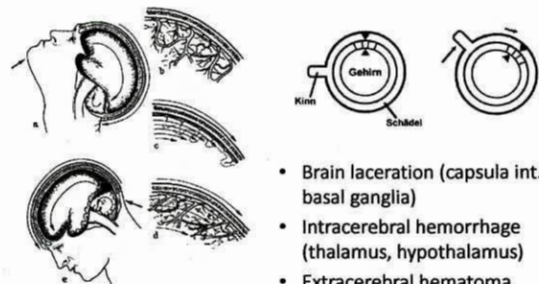
Direct lesion in the upper midbrain, indirekt lesion after uncal herniation (arrow)

Rotational Trauma (Pudenz-Shelden)

Type Ia, Ib, IIa, IIb, IIIa, IIIb, IVa, IVb, VI

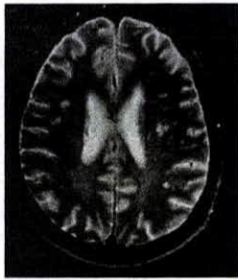
- Intracerebral laceration (basal ganglia, capsula interna)
- Intracerebral hematoma (thalamus, hypothalamus)
- Extracerebral hematoma (subdural, epidural)

Rotational trauma – Scheme Pudenz-Shelden

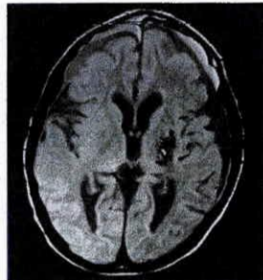


- Brain laceration (capsula int., basal ganglia)
- Intracerebral hemorrhage (thalamus, hypothalamus)
- Extracerebral hematoma (subdural, epidural)

Rotational Brain Trauma Type IIb



White matter lesions, small
hematoma



Lesions:
basalganglia, capsula interna

Different forms of traumatic lesions

- Primary lesions (irreversible)
- Secondary lesions (therapeutic battle field)
Penumbra, postedemic, posthypoxic,
posthypoxicemic (diffuse/local)
- Tertiary lesions (malnutrition, malabsorption,
avitaminosis, bed rest syndrome, etc.)
Encephalopathy, myelopathy, pontine myelinolysis, polyneuropathy
- Quaternary lesions
hydrocephalus occlusus, meningoencephalitis, brain abscess
- Complications
joint contraction, periarticular ossification, decubitus, pressure lesion of
peripheral nerves



Classification of Head Trauma

- Head Injury (HI)
- Brain Injury (TBI)
 - Mild Traumatic Brain Injury (mTBI)
 - Post Concussion Syndrome (PCS)
 - Moderate Traumatic Brain Injury
 - Severe Traumatic Brain Injury
 - Severest Traumatic Brain Injury
- Combined Traumatic Brain Injury with cervical injury
(Whip Lash Injury)

Mild Traumatic Brain Injury Symptoms (P. Vos et al)

- Loss of consciousness (LOC), 5-15 min., max. 20 min.
- Post Traumatic Amnesia (PTA), shorter then 20 min.
- Lack of neurological deficits
- Admission Glasgow Coma Scale (GCS) 13-15
- Head Trauma impact scheme, mostly type I, II

Mild Traumatic Brain Injury Diagnostic program

- Hospital admission obligatory, min. stay 24 hrs., Traumatic Brain Centre desirable
- Neurological examination obligatory
- Accurate history, including accident witnesses, head trauma scheme
- Additional examinations, risk cases, CT, EEG
alcohol, intoxication, children, age more then 65
- Consequent controls by experienced medical personal during hospital stay
- Neurological controls, repeated during hospital stay
- Documentation, check list

Mild Traumatic Brain Injury Treatment

- Admission to hospital care obligatory, min. stay 24 hrs.
- Consequent bed rest
- Medicaments for pain, if necessary
- After discharge, period of rest for 3 days necessary

Post Concussion Syndrome Symptoms

- Loss of Consciousness (LOC) 10 – till 30 min.
- Post Traumatic Amnesia (PTA) shorter then 1 hr., mostly retrograde, anterograde possible
- Physical symptoms: nausea, vomiting, dizziness, head aches
- Neurological deficits: particular frontal, temporal
- Alteration in mental state: dazed, confusion, disorientation
- Emotional disturbances: disinhibition, lability
- Cognitive deficits: impaired cognition, slowed cognitive processing, impaired concentration
- Admission Glasgow Coma Scale 13-14
- Head Trauma impact scheme, mostly type I, II

Post Concussion Syndrome Diagnostic program

- Hospital admission obligatory, traumatic Brain Center desirable, min. stay 48 hrs.
- Neurological examination obligatory
- Accurate history including witnesses
- Additional examinations: CT obligatory, EEG facultative
- Consequent controls by experienced medical personal during hospital stay
- Regular neurological controls, 3 hours period during hospital stay
- Documentation, check list

Post Concussion Syndrome Treatment

- Admission to hospital care obligatory, min. stay 48 hrs.
- Consequent bed rest
- Medicaments for pain, headaches
- Discharge to home with instructions
- After discharge, period of rest for 10 days necessary
- Neurological control after 3 weeks

Basic Differences: MTBI, PCS

	MTBI	PCS
neurological deficits	none	possible (frontal, cerebellar)
EEG	normal	abnormal, possible
cCT	no substantial lesions	brain lesions, possible
cMRI	no substantial damage	local brain damage, detectable
legal consequences	none	insurance covered

Conclusion

Mild Traumatic Brain Injury, "Comotio Cerebri" is a transient dysfunction of the brain, no damage of brain tissue. Functional disturbances, without "morphological alterations" (SPATZ). Legally not declared as physical injury.

Brain Concussion Syndrome, symptoms of extended Mild Traumatic Brain Injury, additional physical disturbances (nausea, vomiting, dizziness) and local brain lesions, EEG mostly abnormal, lesions in MRI detectable, in CT particularly. Legally declared as physical injury, forensic and legal consequences, covered by insurance.

27. český a slovenský neurologický sjezd
a 45. mezinárodní dunajské neurologické symposium

Clarion Congress Hotel Praha 20.-23. listopadu 2013



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and 45th International Danube Neurology Symposium
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