



39th International Danube Symposium
for Neurological Sciences and Continuing Education
in conjunction with the
1st International Congress on ADHS
from childhood to adult disease

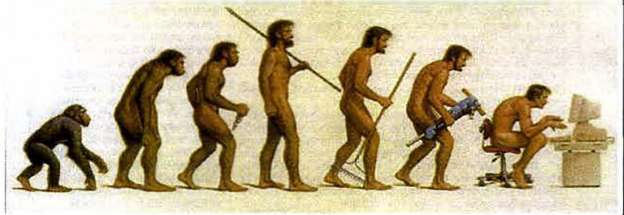


The whiplash injury

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Spinal Cord injuries and whiplash injury
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Introduktion



Evolution from „Homo erectus“ to „Homo sedens“

Vertebral column:
term of the description period of anatomy

Human axis organ:
central organ of the human body

Human axis organ I Functions

- Carrying the weight of the human body
- Carrying the human head with brain and important sensory organs
- Responsible for movements of the head in all dimensions
- Fixation of shoulder girdle and the upper extremities
- Fixation of pelvis with the lower limbs
- Fixation of inner organs:
 - chest with cardio-respiratory organs
 - abdominal organs

Human axis organ II

Regulated by postural and turning reflexes
of the midbrain-pontine centre

- Adaptation of the human body to the gravity field
- Basis for all movements of the human body in the gravity field
- Readaptation of the body position by the postural and turning reflexes due to the vestibular apparatus and the proprioceptive system, receptors of cervical spine, lumbar and thoracic spine

Phylogenetic development of the axis organ, the vertebral column

- Tunicates, external skeleton
- Development of Corda dorsalis (amphioxus)
- Development of cartilage fish
- Development of the vertebral column
 - Horizontal position of the vertebral column
 - bone fish, amphibians, reptiles
 - arch bridge construction, partial developed
 - terrestrial tetrapods (mammalians, aquatic mammalians)
 - arch bridge construction, full developed
 - Vertical position of the vertebral column
 - human being
 - lattice tower construction

Tetrapods arch bridge construction

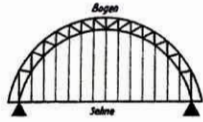


Abb. 6. Schema des Konstruktionsprinzips der Säugerwirbelsäule. Nach SLIZZEN.

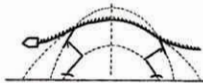


Abb. 4. Schema der Wirbelsäule eines primitiven Säugtieres. Nach BÄCKEN.

- Bow consists of two parts: upper belt and lower belt
- Upper belt: vertebral arch, spine of vertebrae, ligaments, back muscles
- Lower belt: vertebral body, vertebral disc, ligaments, short and long tendons
- bow string: cranial fixed by the ribs (chest), caudal fixed by abdominal muscles

Tetrapods scheme of arch bridge construction

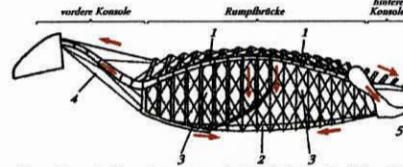


Abb. 7. Schema des Konstruktionsprinzips der Wirbelsäule beim Vierfüßler: 1. Wirbelsäule in Form einer flachen Kyphose; 2. Sehne in Form der langen ventralen Rumpfmuskeln; 3. Querstreben in Form der Rippen und schiefen Rumpfmuskeln

- Flat kyphosis of spine (1)
- Bow string long vertical trunk muscles (2)
- Ribs (chest) and diagonal trunk muscles (3)
- Anterior console (4)
- Posterior console (5)

Vertebral column in tetrapods

- Fixation of the extremities for standing and locomotion
- Support in jumping
- Fixation of inner organs
- Fixation of ribs and the diaphragm for respiration
- Cervical spine
 - Carrying the head with brain, sensory organs including vestibular apparatus
 - Responsible for free movement of the head
 - Receptors for gravity (neck muscles, tendons, cervical joints)
- Tail, used for balance (special motion receptors)
- Balance, continuously regulated by postural and turning reflexes of midbrain centres

Tetrapods

Spine maximal integrated in the running movement, galloping dog - high speed possible

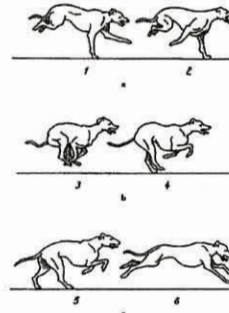


Abb. 8a-c. Bewegungsfolge eines galoppierenden Hundes mit maximaler Beteiligung der Wirbelsäule.

'Great' vertebrates tetrapod and bipeds in normal gravity



Vertebral column change in special biotops

passager lordosis in the lumbar region

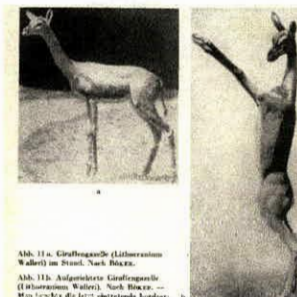


Abb. 11a. Giesberggazelle (Lithocranium Walleri) im Stehen. Nach BÄCKEN.
Abb. 11b. Aufgehobene Giesberggazelle (Lithocranium Walleri). Nach BÄCKEN. — Man beachte die jetzt auftretende Lordose.

- Lithocranium Walleri
- a) Arch bridge construction
- b) Lordosis during feeding

Lift-grasp-climbing position

development of neck and lumbar lordosis
dome construction of vertebral spine



Arch bridge construction
changing to lattice tower construction

Abb. 12. Lordose (schematisch) beim Aufrichten im Zuge des Stemm-Greif-Kletterns.

Lattice tower position



a)



b)

a) Human: lattice tower position

b) Gorilla: lattice tower position, rest of vault bridge construction

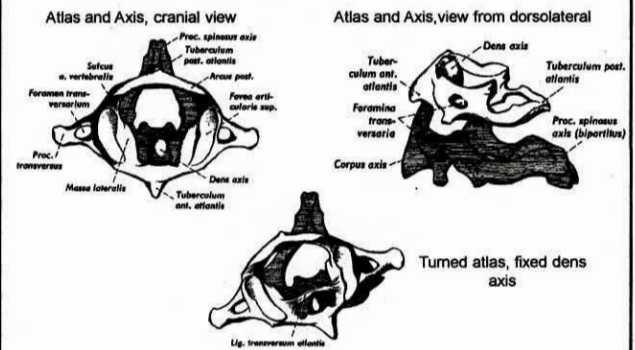
Special function of cervical spine turning movements in 3 dim.

Development of the atlas-axis-system

Three steps:

1. Development of 2 condyles on os occipitale (amphibians)
2. Development of a second level, the atlas-axis-joint, rebuilding of dens by loss of the first disc (tetrapods)
3. Special axis-dens-system, great autonomy, but highly vulnerable

Atlas-Axis-system, different positions



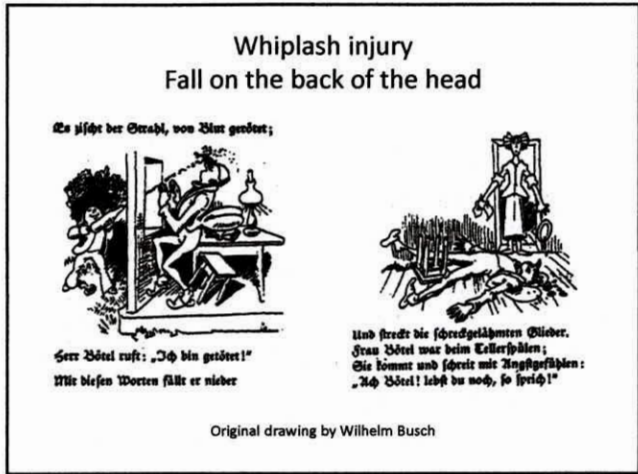
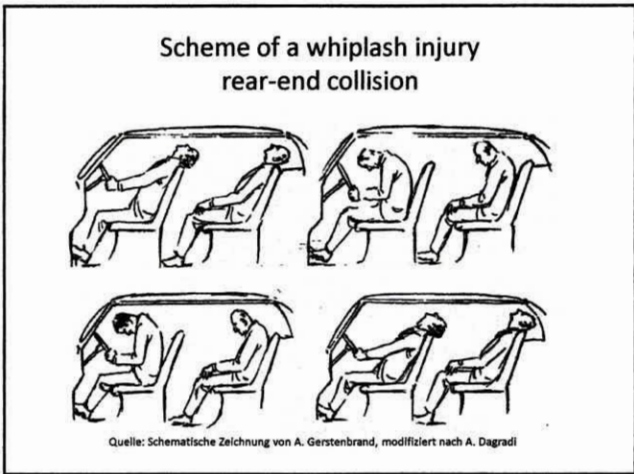
Vulnerability of the human vertebral spine

incomplete development of lattice tower position,
high vulnerability of axis-dens-system

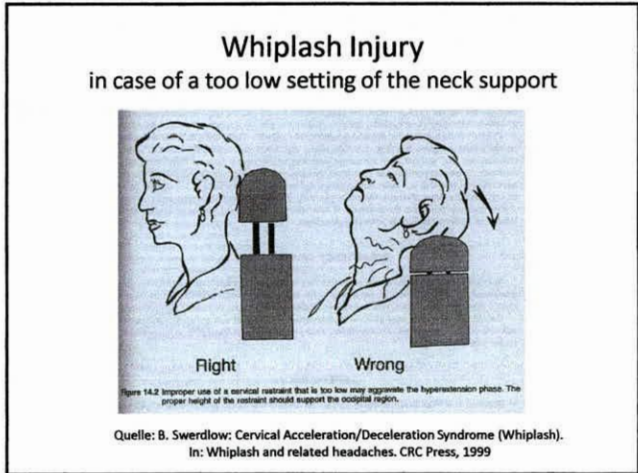
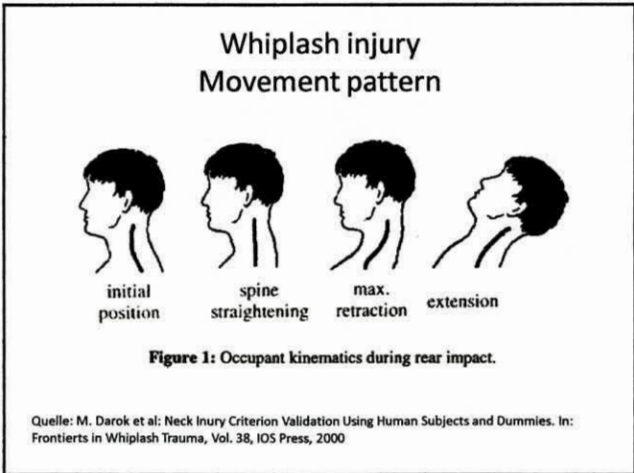
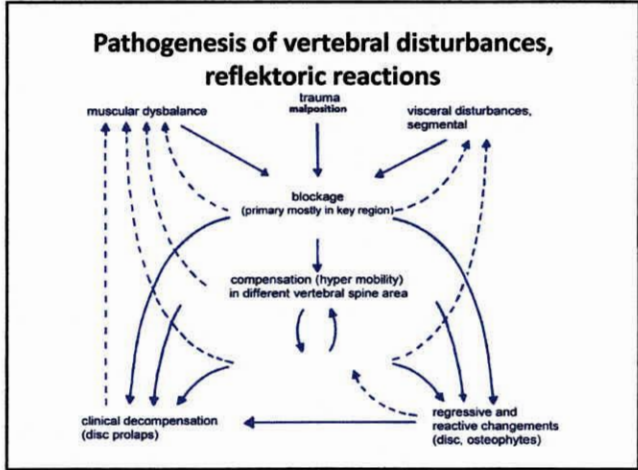
- Overloaded due to unphysiological position (industrial life), typical symptoms of cervical spine and lumbar region (Mumenthaler, Schliack)
- Psychological factors, influencing regional dysfunction of vertebral spine, mainly upper part
- Motion trauma of cervical spine (whiplash injury), mostly including the other parts of vertebral spine (typical acute symptoms, sometimes long-lasting dysfunction, sometimes defect states)

Whiplash injury causes

- Rear-end collision
- Sport injury (ice skating, skiing, etc.)
- Contact sport injury (Rugby, Boxing, Wrestling, etc.)
- Falling on slippery or icy roads on the back of the head (combination with traumatic brain injury possible)



- ### Whiplash Injury Pathophysiology
- Acceleration-/Deceleration movement of the neck
 - Abrupt extension of the whole neck structures (muscles, tendons, discs)
 - Small hemorrhage in the neck tissue
 - Extension of neck vessels
 - Vertebral bone minor fractures possible (rare cases)



Whiplash injury movement pattern

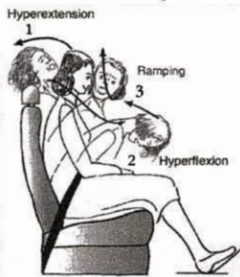


Figure 16.1 Accident/Recreation (or whiplash). After a rear-end collision, the occupant is forced backward into the seat back (hyperextension). There may be a vertical motion called ramping. Following this, the occupant is forced forward or in hyperflexion (see Chapter 15).

Source: B. Swerdlow: Cervical Acceleration/Deceleration Syndrome (Whiplash). In: Whiplash and related headaches. CRC Press, 1999

Whiplash injury Symptoms

- Acute phase
 - Neck pain
 - Neck stiffness
 - Pain during head rotation
 - mostly starting after some hours
- Post acute phase
 - Symptoms of an upper cervical syndrome
 - Headache
 - Cervicalgia
 - Vertebral vertigo
 - additional symptoms
 - Pseudo-radicular symptoms in upper extremities,
 - Low back pain (Lumbago)

Whiplash injury Obligatory Course

- Acute phase:
 - Improvement after 4 to 10 days
- Post acute phase:
 - Complaints for 6 to 10 weeks
- Phase of complaints:
 - Up to 3 months, sometimes up to 10 months
- Defect state:
 - Transition to upper cervical syndrome

Upper cervical syndrome

Combined symptoms:

- Cervical headache
- Cervicalgia
- Migraine cervicale (old terminology)
- Cervical dizziness
 - attacks of vertigo, spontaneous or due quick movements of the head

Additional symptoms:

- middle or lower cervical syndrome,
- cervico-dorsalgia, dorsalgia, lumbalgia
- combination with pseudo-radicular symptoms (thoracal, lumbo-sacral)

Whiplash injury diagnostic methods

- Neurological examination
- X-ray of cervical spine
- Functional X-ray of cervical spine
- X-ray of thoracic and lumbar spine
- MRI of cervical spine (in severe cases)
- Manual therapeutic examination methods
- In subsequent course neuro-orthopedic examination

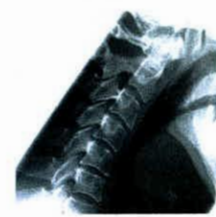
X-ray Cervical Spine

female patient, 47^a

Upper cervical syndrome with whiplash injury



a) Retroflexion, blockage upper part, dysbalance occipito-atlanto-axial



b) Anteroflexion, blockage in upper part and lower part of cervical spine

Whiplash injury treatment

- Ice application during the first 24 hours
- Bed rest for 24 hours up to 5 days
- Cervical collar
- Muscle relaxing medication
- In case of severe pain analgesics

- Gentle active movements beginning after 2 to 5 days
- Systematic physiotherapy after 10 to 20 days depending on pain state
- Local infiltration with xylocaine in cases of severe muscle tension

Summary

- Whiplash injury is a common traffic trauma (rear end collision)
- Whiplash injury occurs in sport accidents and falling backwards
- Typical acute symptoms usually occurring within some hours after accident
- Typical post acute symptoms
- Great differences in the defect status, chronic course
- Medico-legal aspects, difference in various countries
- Diagnosis „whiplash injury“ has negative resonance in assurance compensation



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