

THE VERTEBRAL SPINE AND NEUROLOGICAL DISTURBANCES, DIAGNOSIS AND TREATMENT

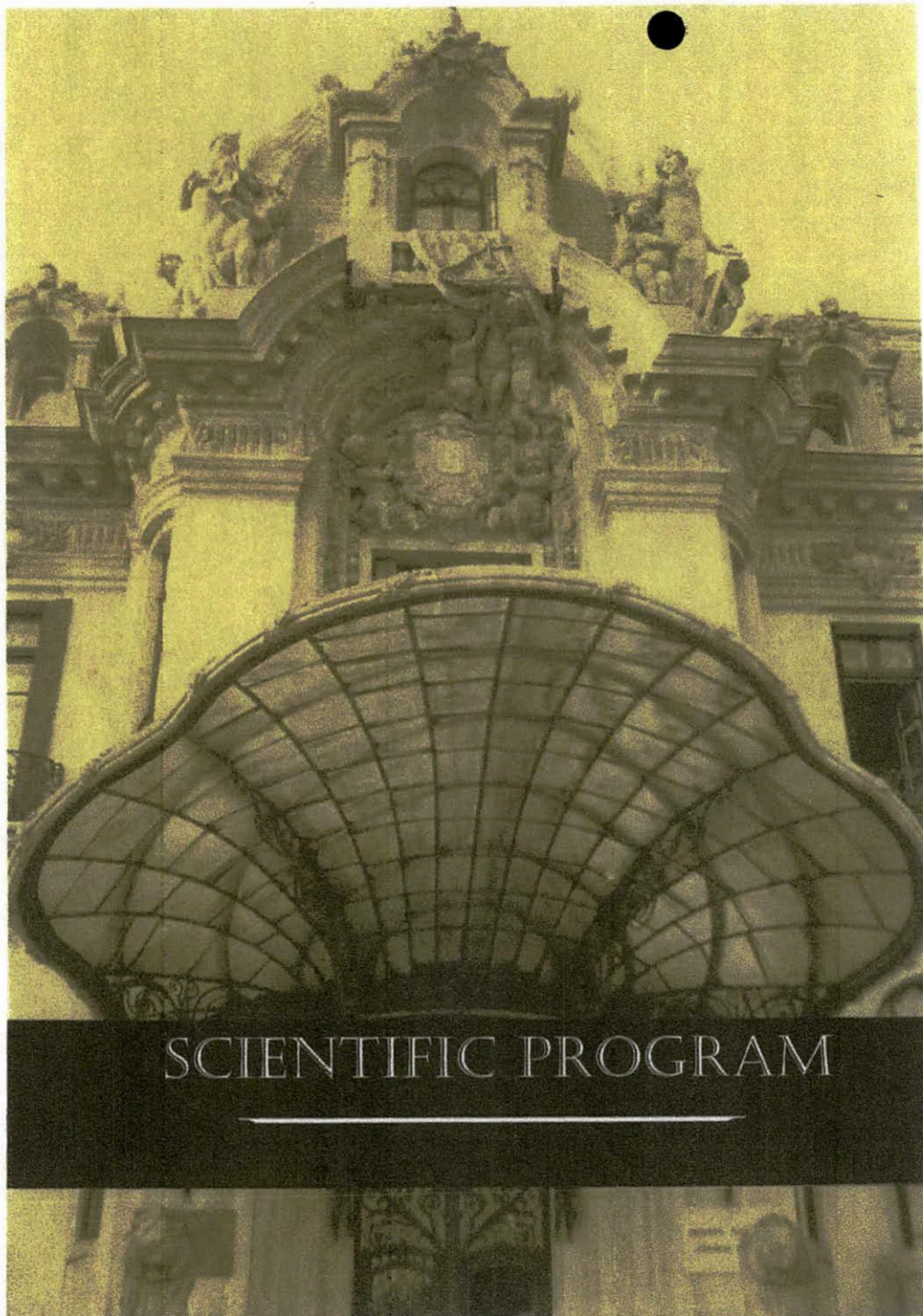
F. Gerstenbrand, Vienna,
S. Golaszewski, Salzburg
G. Pichler, Graz

The term vertebral spine goes back to the description period of anatomy. As a consequence of the central position in the human body, the spinal column should be called the "human axis organ". The center for the function of the axis organ is located in the brain stem using the postural and turning reflexes, based on the stimulation of the proprioceptive system. Main receptors of the proprioceptive system are the mechanoreceptors of joints and muscles of the extremities and the vertebral spine, supported by foot sole receptors. The human axis organ is the basis of static and kinetic functions of the human body. The axis organ is carrying the body, the extremities and the head. The inner organs and the thorax with the breathing system are fixed onto the axis organ. The spinal cord is located in the spinal channel of the vertebral spine.

During phylogenesis the bridge-bow-construction of quadrupeds had changed into the lattice tower system, the upright position of the human race and the following development of manhood. The filigree vertebral bones and the vulnerable discs have to carry the weight of the body and the head using the "arc function model".

The situation of modern men, "the homo sedens", with the functional overload in the non-physiological body position produces a continuous damage in all parts of the vertebral spine. In addition, psychological factors are influencing position and movements of the body too. Degenerative changes on vertebrates, discs and vertebral joints are the consequence, causing typical complaints in form of radicular syndromes, pseudoradicular symptoms and the referred pain syndrome as well as spinal cord deficits and cauda symptoms. The spondylogenic cervical myelopathy is a sequence of a vertebrostenosis in the cervical spine, often misdiagnosed, modifications of a spondylolisthesis, especially in the lumbar spine region, are a problem in diagnosis and treatment. The "whiplash injury" of the cervical spine can be followed by chronic complains based on degenerative alterations of the cervical spine.

Special neurological examination including the method of the manual therapy (neuro-orthopedics) together with X-ray examination, completed by the magnetic resonance method and an electrophysiological examination have to be used for an exact diagnosis and a special treatment program, which needs to be carefully prepared and consequently executed by specially trained physiotherapists. For the decision of a surgery intervention a careful consultation between the different specialists (neurology, orthopedics, neurosurgery) is necessary.



SCIENTIFIC PROGRAM



Romanian Medical Academy Brain Days

3-5/09/2010 Intercontinental Hotel, Bucharest

SCIENTIFIC PROGRAM

03.-05.09.2010

SATURDAY / 4 September 2010

- 09:00 – 09:10 **Welcome Address:** Laurențiu M. Popescu (Romania), Dafin F. Mureșanu (Romania), Florian Popa (Romania)
- 09:10 – 09:40 **Opening Lecture**
Dafin F. Mureșanu (Romania) **REAPPROACHING THE CONCEPTS AND REDESIGNING THE CLINICAL TRIALS FOR BRAIN PROTECTION AND RECOVERY**
- Session 1 – Dementia (I) / Chairmen:** Raul Arizaga (Argentina), Jakub Hort (Czech Republic)
- 09:40 – 10:00 **Philip Scheltens** (The Netherlands) **RETHINKING THE DESIGN OF CLINICAL TRIALS IN AD**
- 10:00 – 10:20 **Antón Álvarez** (Spain) **ALZHEIMER'S DISEASE: PLEIOTROPIC AND MULTIMODAL TREATMENT FOR A MULTIFACTORIAL DISORDER**
- 10:20 – 10:40 **Amos Korczyn** (Israel) **WHY HAVE WE FAILED TO FIND A CURE FOR AD?**
- Discussion – 15 minutes**
- 11:00 – 11:30 **Coffee Break**
- Session 2 – Dementia (II) / Chairmen:** Amos Korczyn (Israel), Philip Scheltens (The Netherlands)
- 11:30 – 11:50 **Angel Cedazo-Minguez** (Sweden) **APOLIPOPROTEIN E, CHOLESTEROL AND ALZHEIMER'S DISEASE**
- 11:50 – 12:10 **Jakub Hort** (Czech Republic) **HUMAN ANALOGUE OF MORRIS WATER MAZE IN THE ASSESSMENT OF INDIVIDUALS AT RISK OF ALZHEIMER DISEASE**
- 12:10 – 12:30 **Antonio Federico** (Italy) **RARE NEUROLOGICAL DISEASES: SIENA EXPERIENCE IN DIAGNOSIS, TREATMENT, RESEARCH AND TEACHING**
- 12:30 – 12:50 **Raul Arizaga** (Argentina) **COGNITIVE IMPAIRMENT AND DEMENTIA: PATHWAYS AND BARRIERS**
- Discussion – 15 minutes**
- 13:10 – 14:10 **Lunch**




Romanian Medical Academy Brain Days
 3_3/09/2010 Intercontinental Hotel, Bucharest

SATURDAY / 4 September 2010

Session 3 – TBI / Chairmen: Pieter Vos (The Netherlands), Antón Álvarez (Spain)

14:10 – 14:30	Pieter Vos (The Netherlands)	ARE S100B AND GFAP GOOD BIOMARKERS OF MODERATE AND SEVERE TRAUMATIC BRAIN INJURY?
14:30 – 14:50	Franz Gerstenbrand (Austria)	THE VERTEBRAL SPINE AND NEUROLOGICAL DISTURBANCES, DIAGNOSIS AND TREATMENT
14:50 – 15:10	Alexandru V. Ciurea (Romania)	EARLY NEUROPROTECTION AND RECOVERY IN SEVERE TRAUMATIC BRAIN INJURY
Discussion – 15 minutes		

Session 4 – Neurorehabilitation (I) / Chairmen: Franz Gerstenbrand (Austria), Heinrich Binder (Austria)

15:30 – 15:50	Klaus von Wild (Germany)	HRQOL, HEALTH RELATED QUALITY OF LIFE, FOLLOWING TBI IN ADULTS. THE NEUROSURGEONS PERSPECTIVE.
15:50 – 16:10	Volker Hömberg (Germany)	MOTOR REHABILITATION: WHAT CAN WE LEARN FROM BASIC SCIENCE?
16:10 – 16:30	Tamás Z. Kincses (Hungary)	INVESTIGATION OF PLASTICITY TO DEVELOP NOVEL REHABILITATION APPROACHES
Discussion – 15 minutes		

16:50 – 17:20 **Coffee Break**

Session 5 – Neurorehabilitation (II) / Chairmen: Klaus von Wild (Germany), Volker Hömberg (Germany)

17:20 – 17:40	Heinrich Binder (Austria)	CONCEPTION OF CONSCIOUSNESS IN NEUROREHABILITATION
17:40 – 18:00	Steven Laureys (Belgium) represented by Camille Chatelle	CONSCIOUSNESS IN COMA AND RELATED STATES
Discussion – 15 minutes		

20:30 **Gala Dinner**


Romanian Medical Academy Brain Days
 3_3/09/2010 Intercontinental Hotel, Bucharest

SUNDAY / 5 September 2010

Session 6 – CNS Injury, protection and plasticity / Chairmen: Hari Shanker Sharma (Sweden), Ovidiu Băjenaru (Romania)

09:00 – 09:20	Hari Shanker Sharma (Sweden)	HYPERTENSION, DIABETES OR NANOPARTICLES EXPOSURE AS DISEASE MODIFYING FACTORS EXACERBATE PATHOPHYSIOLOGY OF HYPERTHERMIA INDUCED BRAIN DAMAGE AND ATTENUATE NEUROPROTECTIVE EFFICACY OF THERAPEUTIC AGENTS
09:20 – 09:40	Ovidiu Băjenaru (Romania)	PATHOPHYSIOLOGICAL MECHANISMS OF NEUROPATHIC PAIN
09:40 – 10:00	Moussa Youdim (Israel)	WHY IS NO WIN FOR ALZHEIMER'S AND PARKINSON'S SYNDROMES AND THE NEED FOR MULTIMODAL DRUGS
Discussion – 15 minutes		

10:20 – 10:50 **Coffee Break**

Session 7 – Dementia (III) / Chairmen: Antonio Federico (Italy), Moussa Youdim (Israel)

10:50 – 11:10	Stavros J. Baloyannis (Greece)	THE PHILOSOPHY OF DEMENTIA
11:10 – 11:30	Bogdan O. Popescu (Romania)	IMPACT OF THE BLOOD BRAIN BARRIER ALTERATIONS ON NEURODEGENERATION
11:30 – 11:50	Luiza Spiru (Romania)	PRODROMAL COGNITIVE IMPAIRMENT (PCI) - A KEY NOTION FOR DEMENTIA MANAGEMENT. CUTTING-EDGE INSIGHTS
Discussion – 15 minutes		

12:15 – 12:30 **Closing Remarks** Dafin F. Mureşanu (Romania), Laurenţiu M. Popescu (Romania)

12:30 **Lunch**



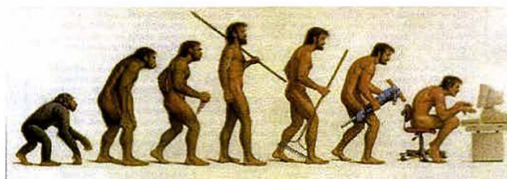
The Vertebral Spine and Neurological Disturbances, Diagnosis and Treatment

F. Gerstenbrand^{1), 2)},
St. Golaszewski³⁾, G. Pichler⁴⁾

¹⁾ Department of Neurology, University Innsbruck
²⁾ Karl Landsteiner Institute of Neurorehabilitation and Space Neurology, Vienna
³⁾ Neurological Department of Christian Doppler University, Salzburg
⁴⁾ Apallie Care Unit, Albert-Schweitzer-Clinic, Graz

Romanian Medical Academy Brain Days
Bucharest, Romania
September 3 - 5, 2010

Introduction



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 cardiorespiratory organs
 - abdominal organs

Human axis organ II

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

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

Development of the axis organ, the vertebral column

- Tunicata, external skeleton
- Development of Chorda dorsalis (amphioxus)
- Development of cartilage fish
- Development of the vertebral column

Development of the vertebral column

- Horizontal position of the vertebral column
 - bone fish, amphibians, reptiles
 - arch bridge construction, partial developed
 - terrestrial tetrapods (mammals, aquatic mammals)
 - arch bridge construction, full developed
- Vertical position of the vertebral column
 - human being
 - lattice tower construction

Tetrapods arch bridge construction

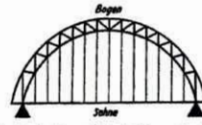


Abb. 6. Schema des Konstruktionsprinzips der Säugerwirbelböle. Nach Stäppen.

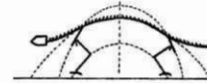


Abb. 4. Schema der Wirbelböle eines primitiven Säugetieres. Nach Böckx.

- Bow consists of two parts: upper belt and lower belt
 - Upper belt: vertebral arch, spine of vertebra, 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

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)
- Change of balance, continuous regulated by postural reflexes of midbrain

Tetrapods

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

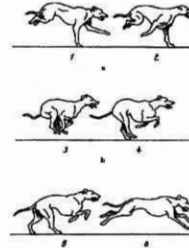


Abb. 8. Bewegungsphasen eines galoppierenden Hundes mit maximaler Beteiligung der Wirbelböle.

'Great' vertebrates tetrapod and bipeds in normal gravity



Vertebral column change in special biotopes passage lordosis in the lumbar region



- Lithocranium Walleri
- Arch bridge construction
 - Lordosis during feeding

Abb. 11 a. Graffingazelle (Lithocranium Walleri) im Stand. Nach Böckx.

Abb. 11 b. Aufgerichtete Graffingazelle (Lithocranium Walleri). Nach Böckx. — Man beachte die jetzt verteilte Lordose.

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

Homo erectus, lattice tower position

dome function of the vertebrates



Cervical lordosis
thoracic kyphosis
thoracic-lumbar lordosis
fixed kyphosis of sacrum

Design of the human vertebral column, uncompleted, Koch 1964

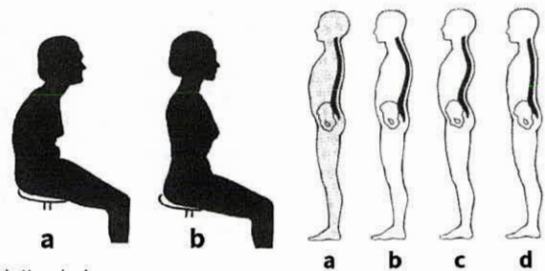
Vulnerability of the human vertebral spine

- unfinished development of lattice tower construction
- insufficient vertebral muscles
- vulnerability of vertebral disc
- high vulnerability of axis-dens-system
- overloaded system to non-physiological position and movements (industrial life)
- psychological factors (psychic tensions), dysfunction mainly of upper part,
- typical symptoms of cervical spine dysfunction, less thoracic region
- motion trauma of cervical spine (whiplash injury), sometimes including other parts of vertebral spine

Cause of Disturbances of the Vertebral Spine

- Overloaded functions
- Malposition
- Mal-stereotypes of movement
- Hyper mobility
- Hypo mobility
- Vertebral muscle dysfunction
- Inborn abnormalities (scoliosis, pelvis)
- Local lesions (traumatic, inflammatory)

Malposition



a) Humpback
b) Normal position

a) Normal position
b) Humpback
c) Humpback, lumbar hyperlordosis
d) Flatback

Quelle:
H. Tilscher: Die Wirbelsäule der Frau.
Verlagshaus der Ärzte, Wien, 2005

Malposition



- Insufficient muscles of the neck, the back and the abdominal muscles
- Over weighted

Quelle:
H. Tilscher: Die Wirbelsäule der Frau.
Verlagshaus der Ärzte, Wien, 2005

Change Between Supporting and Free Leg



- Malposition
- Malstereotypes
- Overloading of lumbar spine, partly insufficient back muscles

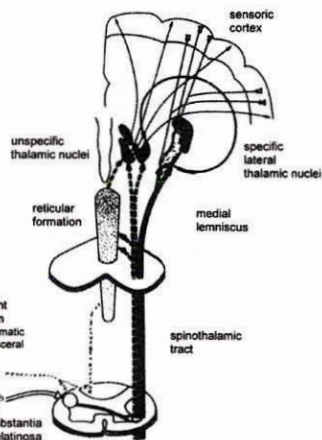
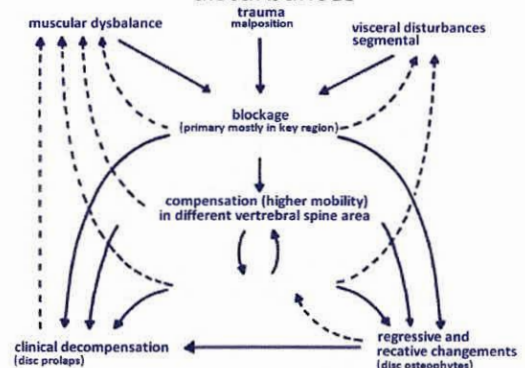
Quelle:
H. Tilscher: Die Wirbelsäule der Frau.
Verlagshaus der Ärzte, Wien, 2005

Malposition - Malfunction



- caused by profession (violinist)

Pathophysiology of vertebragen disturbances



Vertebragen Disturbances Sensory Pathways

Vertebragene disturbances Neurological manifestations

- Acute decompensation of vertebral spine
 - Lumbago attacks, stiff neck syndrome
 - Protection mechanism for local lesion
- Lesion of vertebral roots
- Lesion of spinal cord
- Disturbances in the blood circulation of nervous structure (spinal cord, nervous roots, cauda)

Lumbago Attack

- Severe back pain, sudden onset, (lumbar region – lower thoracic region)
- Stretched position in lower part of vertebral spine – “Improvisationshaltung”
- Total immobilization of the body
- Radicular symptoms in 15%
- Pseudo-radicular symptoms in 30%
- Etiology: Acute lesion, disc herniation, decompensation of spondylolisthesis lumbar spine
- Protection mechanism for local process

Stiff Neck Syndrome

- Severe neck pain, acute attack
- Stretched-torsion position of the neck
- Immobilization of head movement
- Pseudoradicular symptoms C2, C3, C4
- Radicular symptoms C2 – C4
- Acute lesion cervical spine (disc herniation, decompensation of spondylolisthesis, etc.)
- Protection mechanism for local process

Radicular Syndrome

- Pain in the dermatome
 - Dragging, drilling, most intensive
- Sensory disturbances in the dermatome
 - Hypalgesia, analgesia
- Paresis, atrophy in the myotome
 - Hyporeflexia, areflexia
- No vegetative disturbances

Pseudoradicular Syndrome

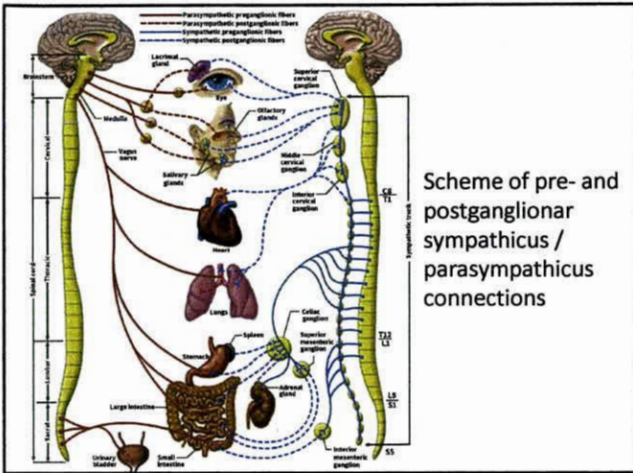
- Pain in one or several dermatomes
 - one/both sides, blunt – diffuse
- Dysesthesia, hyperalgesia in the affected dermatome
 - no sensory deficits
- No motor deficits
 - Increased muscle tonus in the myotome
 - Increased tendon reflexes possible
- Vegetative disturbances
 - Hyperhidrosis, piloerection, Kibler phenomena
- Blockage in the affected spinal movement segment

Visceral Referred Pain Syndrome

- Affection of inner organs
- Affection of joints
 - in extremities
 - of vertebral spine

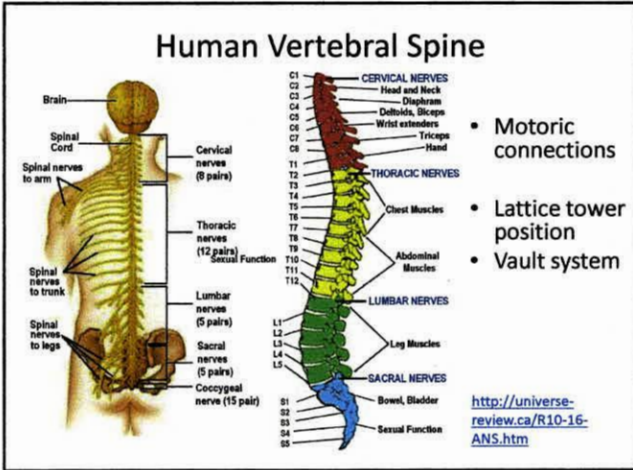
Visceral Referred Pain Syndrome Affection of Inner Organs

- Pain in “head zones” belonging to the affected organ
 - Burning pain
- Hypalgesia/dysesthesia in the associated dermatome
 - No sensory deficits
- No motoric dysfunction
 - Painful muscle spasm in the enterotome – myotome
 - maximum in the “MacKenzie zone”
- Vegetative disturbances in the associated dermatome
 - Hyperhidrosis, Kibler phenomenon, piloerection
- Signs of local irritation, local pains, pressure pains
- Functional disturbances of the damaged organ
- Protection mechanism



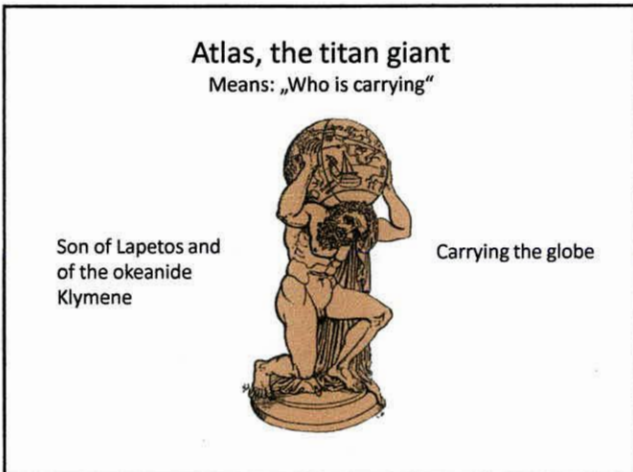
Visceral Referred Pain Syndrome
Affection of Joints in the Movement Organs
Extremities, Vertebral Spine

- Pain in the dermatome of the affected joint
- Hyperalgesia/dysesthesia in the affected dermatome
- No sensory deficits, no paresis
 - Increased muscle tonus of the affected muscles (cramps)
 - Tendinopathy, myogelosis, tendomyositis
- Pressure pain in the affected joint
- Joint blockage, in movement pains
- Vegetative disturbances possible (Hyperhidrosis, Kibler phenomenon, etc.)



Most Affected Areas of the Vertebral Spine

1. Cervical spine
2. Lumbar spine
3. Thoracic spine



Special function of cervical spine
turning movements in 3 dim.
Development of the Atlas-Axis-system

Three steps:

1. development of 2 condyls on os occipitale (amphibias),
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 in human beings

Dysfunction of Cervical Spine Neurological Manifestations

- Cervicogene headache
- Cervical syndromes
- Vertebrobasilar insufficiency
- Cervical vertebral stenosis (spinal cord lesion)

Cervical Syndromes

- Upper cervical syndrome
 - C2, connection to N. trigeminus
 - C1 no posterior root
- Middle cervical syndrome
 - C3, C4, C5
- Lower cervical syndrome
 - C6, C7, C8, D1

Upper Cervical Syndrome

- Headache, cervicogene type
 - Blunt – diffuse pains
 - Helm feeling
 - “band around the head”
 - Face pain - pseudo-trigeminal pain
- Cervicalgia
 - Neck pain
- Vertigo (turning of the surrounding)
- Vertebrobasilar insufficiency attacks (VBI) possible
- Migraine cervical attacks possible

Middle Cervical Syndrome

- Pseudoradicular symptoms C3, C4, C5
 - Pain in the affected dermatome
 - Dysesthesia, hyperalgesia
 - No sensory deficits
 - No motoric deficits
 - Vegetative symptoms, heart sensations
 - Palpitation
 - Tachyarrhythmia
 - Suspicious heart infarct
 - Tachycardia
 - Disturbance of diaphragm, high level position

Lower Cervical Syndrome

- Pseudoradicular symptoms C6, C7, C8, D1
- Pain in the affected dermatome
- Dysesthesia, hyperalgesia
- No sensory deficits
- No motoric deficits

- Synonym: shoulder-arm-syndrome

Cervicogenic headache Symptomatology

- Pressure headache type, neck occipital to forehead, both sides, seldom one side
- Helm-feeling, ring-shaped feeling
- Pressure feeling retro bulbar region
- Increase of pain during coughing,
- Initiation due to external influence
 - local cooling, trauma of cervical spine, etc.
- Additional pain symptoms:
 - pain distribution in C2, C3, C4 with dysesthesia
 - atypical face pain
 - pseudo-trigeminal pain

X-ray Cervical Spine

female patient, 47^a

Diagnosis: cervicogenic headache



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



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

Cervical MRI

Female patient, 47^a

Diagnosis: cervicogenic headache



Stretch position of cervical spine, mostly upper part, multisegmental disc protrusion, incipient vertebral stenosis C5/C6

Vertebrobasilar Insufficiency (VBI) Attacks

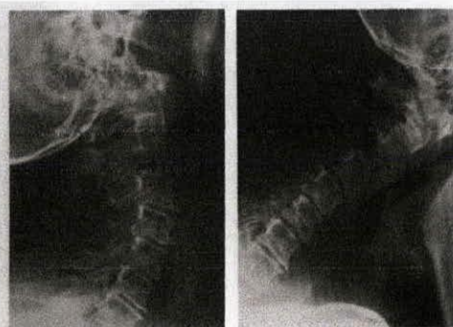
- Symptoms
 - Headache, bilateral, neck pain (cervicalgia)
 - Vertigo (turning feeling)
 - Cerebellar disturbances (shaking feeling), possible
 - Visual disturbances (double vision)
 - Tinnitus
 - Drop-attacks (cardiac syncope)
 - Amnesic episodes
- Differential diagnosis
 - Mechanical irritation of the craniocervical region
 - Vertebrobasilar syndrome

Cervical Spondylogene Myelopathy

- Symptoms
 - Flaccid paresis of spreading hands
 - Atrophy of hand muscles both sides
 - Spastic paraparesis of legs
 - Dissociated sensory disturbance C6 downwards
 - Epicritic disturbances, legs, trunk, upper extremities
 - Bladder dysfunction, urge to urinate
 - Bowel dysfunction
 - Vertebral stenosis cervical spine, middle-lower part
- X-ray, cervical MRI
 - typical findings
- Differential diagnosis
 - A. spinalis anterior syndrome

Vertebrostenosis

Change ment in various head position



Cervical Vertebrostenosis



- MRI, cervical (T2)
- Disc protrusion C5/C6 and C6/C7
- Stretched position lower part in cervical spine

Cervical Vertebrostenosis



- Myelography
- Disc protrusion C4/C5, C5/C6

Cervical Vertebrostenosis Cervical MRI (T2)

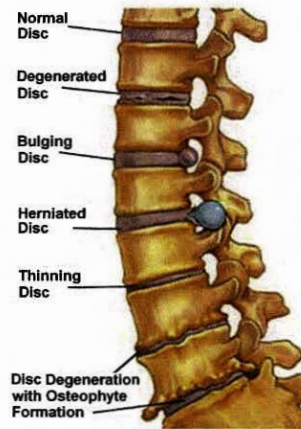


- Severe spondylogene cervical myelopathy, vertebral stenosis C5/C6, C6/C7
- Local lesion in the myelon C6

Problems of the Lumbar Spine

- Carrying the body weight
- Malposition
- Malfunction
- Malstereotypes
- Muscle malfunction
- Muscle insufficiency
- Spondylolisthesis

Examples of Disk Problems



Disc Problems of the Lumbar Spine

Symptoms of Disturbances of the Lumbar Spine

- Radicular symptoms according to the local affection (affected disc herniation, etc.)
- Pseudo-radicular symptoms associated to the affected local structure (discs, spinal joints, etc.)
- Conus-Cauda symptoms, affection of lower lumbar spine L1/ L2
- Cauda lesion, affection in the lower lumbar spine, downwards to L2

Spondylolisthesis, Vertebrostenosis of Lumbar Spine

- Symptoms with the affected lumbar segments
 - Radicular symptoms (uni-radical, multi-radical)
 - Cauda symptoms – Conus-cauda symptoms
 - Pseudo-radicular symptoms
- Clinical compliance
 - Claudicatio lumbalis
- Differential diagnosis
 - Local process in the spinal channel (L2 downwards)

Spondylolisthesis



Pat. H.F., female, 44^a
 Functional myelogram
 Radicular syndrome L3
 both sides
 Increased bulging effect
 in reclination

Lumbar Disc Herniation Vertebrostenosis



- Lumbar disc herniation
L3/L4, L4/L5
70^a old patient
- Nervous root compression
L2/L3 (arrow)
- Diagnosis:
Claudicatio lumbalis
- a) MRT (T1)
- b) myelography

Source: M. Mumenthaler, H. Mattie,
 Neurologie, Abb. 13.12

Thoracic Vertebral Spine Problems

- Disc prolapse (seldom)
 - Radicular lesion
 - Spinal cord lesion
 - Pseudo-radicular symptoms
- Disc protrusion
 - Pseudo-radicular symptoms, correlated to the affected segment
 - Visceral referred pain syndrome caused by joint lesion
- Differential diagnosis
 - Visceral referred pain syndrome, caused by the affected inner organ

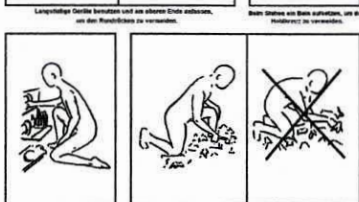
Treatment of vertebral spine processes

- Reparation of the malposition, malstereotypes, disturbed movement
- Reorganization of wrong posture of the vertebral column, the axis organ
- Reorganization of the disturbed muscles of the vertebral spine
- Tools:
 - Physiotherapy using various methods
 - Surgical treatment only the last choice
- Prophylaxis

Vertebral Spine - Prophylaxis



Some possibilities



Source: J. Krämer, Prophylaxe von
 Wirbelsäulenschäden am Arbeitsplatz,
 in: Neuroorthopädie 4, 1988

Abb. 3. Prophylaxe von Wirbelsäulenschäden in Haushalt und Garten (Krämer 1988 b)

Isometric Exercises

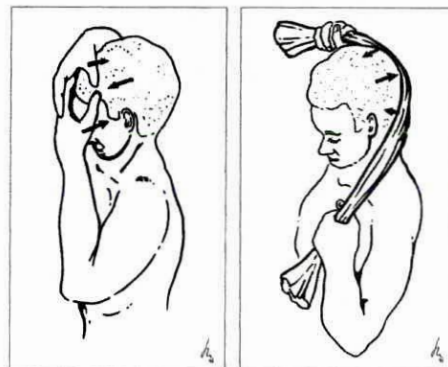


Abb. 51 Isometrische Kräftigungsübungen gegen die eigenen Hände

Abb. 52 Isometrische Kräftigungsübungen gegen ein Handtuch

Source: Degenerative
 Erkrankungen der
 Halswirbelsäule,
 Goldhahn et al, 1994

Special Exercises for the Vertebral Spine

Abb. 20: Falsche Übungen machen krank: Hüftbeckenverlagerung
a) falsch, b) richtig

Abb. 21: Klappmesser
a) falsch, b) richtig

Abb. 22: Diagonales Rumpfbiegen
a) falsch, b) richtig

- Left side: wrong execution

Quelle:
H. Tilscher: Die Wirbelsäule der Frau.
Verlagshaus der Ärzte, Wien, 2005

Special Exercises for Stretching the Backside Thigh Muscle and Lumbar Spine

Abb. 23: Dehnung des hinteren Oberschenkelmuskels
a) und c) falsch, b) und d) richtig

- a) and c): wrong execution

Quelle:
H. Tilscher: Die Wirbelsäule der Frau.
Verlagshaus der Ärzte, Wien, 2005

From tetrapods to homo sedens
Vulnerability of the spine to direct impacts and to malfunction due to the industrial life.
Intensive prophylactic program necessary.

Evolution from „Homo erectus“ to „Homo sedens“