

Physiotherapy, Stomatology (2024)

# FUNCTIONAL ANATOMY OF CERVICAL SPINE

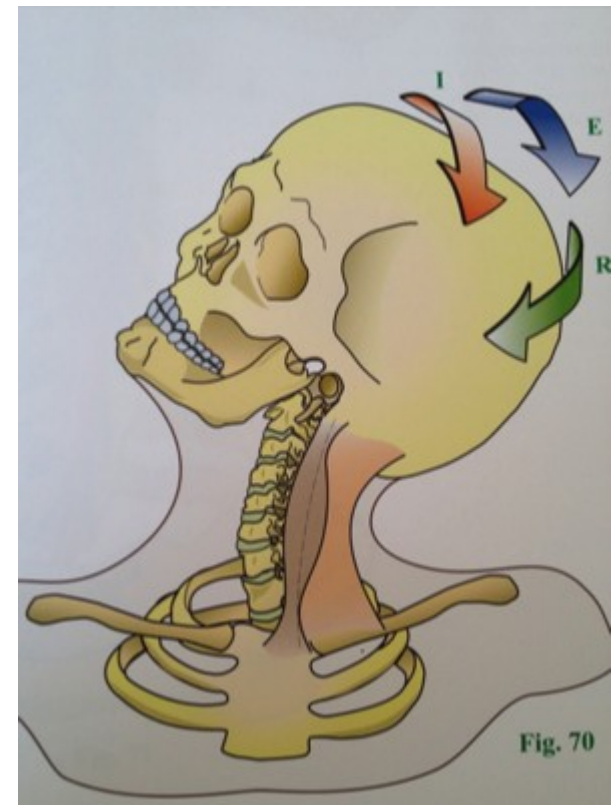
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# Content

- Functional anatomy of cervical spine
- Mobility of cervical spine
- Cervical vertebrogenic disorders
- Examination of the neck
- The Basic Physiotherapeutic Measures
- Back school, ergonomics

# Functional Anatomy

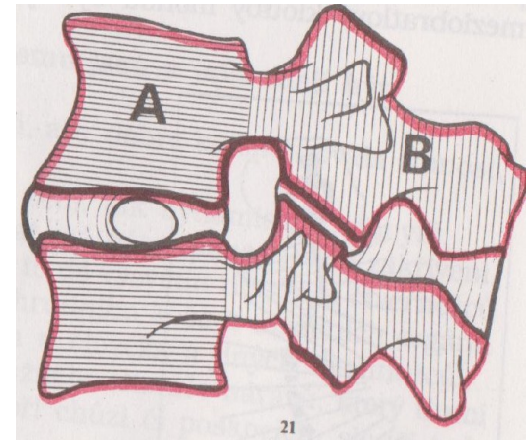
= the anatomy of the function which deals with structural assumptions for working of musculoskeletal system and describes activity of muscles and joints



Kapandji textbook on functional anatomy

# Motion segment

= a basic element of axial system



**2 points of view:**

- ✘ from **anatomical point of view** it consists of: neighbours vertebrae, intervertebral joints, intervertebral disc, fixation ligaments and muscles
- ✘ from **functional point of view** it consists of 3 basic components:
  - ✚ supporting and passively fixating: vertebrae and intervertebral ligaments
  - ✚ hydrodynamic : intervertebral disc and spinal vascular system
  - ✚ kinetic and actively fixating: spine's joints and muscles

# Spinal Sector

- consists of groups of motion (spinal) segments
- anatomical division of sectors is not the same as the functional one

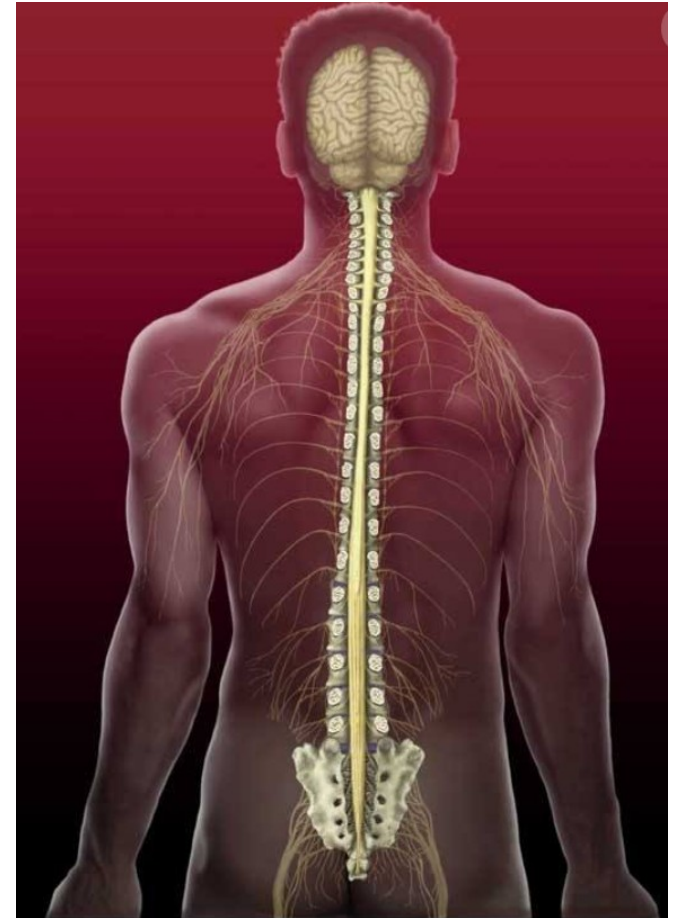


# Spinal sectors

<b>Anatomic division</b>	<b>S E C T O R</b>	<b>Extent</b>
<b>Cervical spine</b> (vertebrae cervicales, C <sub>1</sub> - C <sub>7</sub> )	<b>The upper cervical</b> <b>(craniocervicalis) sector</b> <b>The lower cervical</b> <b>(cervicothoracicalis) sector</b>	<b>Os occipit. + C<sub>1</sub> - C<sub>3</sub></b>  <b>C<sub>3</sub> - Th<sub>4</sub></b>
<b>Thoracic spine</b> (vertebrae thoracicales Th <sub>1</sub> - Th <sub>12</sub> )	<b>The upper (cervicobrachialis)</b> <b>sector („the upper chest “)</b> <b>The lower sector („the lower</b> <b>chest “)</b>	 <b>C<sub>6</sub> - Th<sub>7</sub></b>  <b>Th<sub>6</sub> - L<sub>2</sub></b>
<b>Lumbar spine</b> (vertebrae lumbales, L <sub>1</sub> - L <sub>5</sub> )	<b>The upper lumbar sector</b> <b>The lower lumbar sector</b>	 <b>Th<sub>9</sub> - L<sub>3</sub></b> <b>L<sub>3</sub> - S<sub>1</sub></b>

# Function of the spine

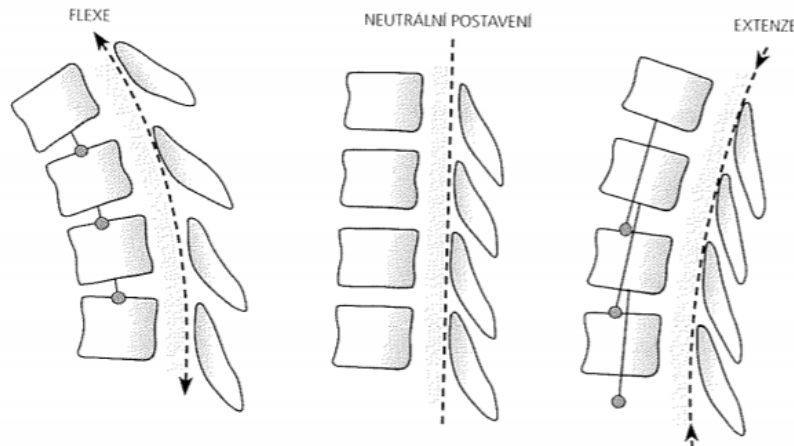
- protection of neural structures
- supporting function
- motion axis of the body
- participation in maintaining the balance



<https://www.quora.com/What-is-the-function-of-the-neural-spine>

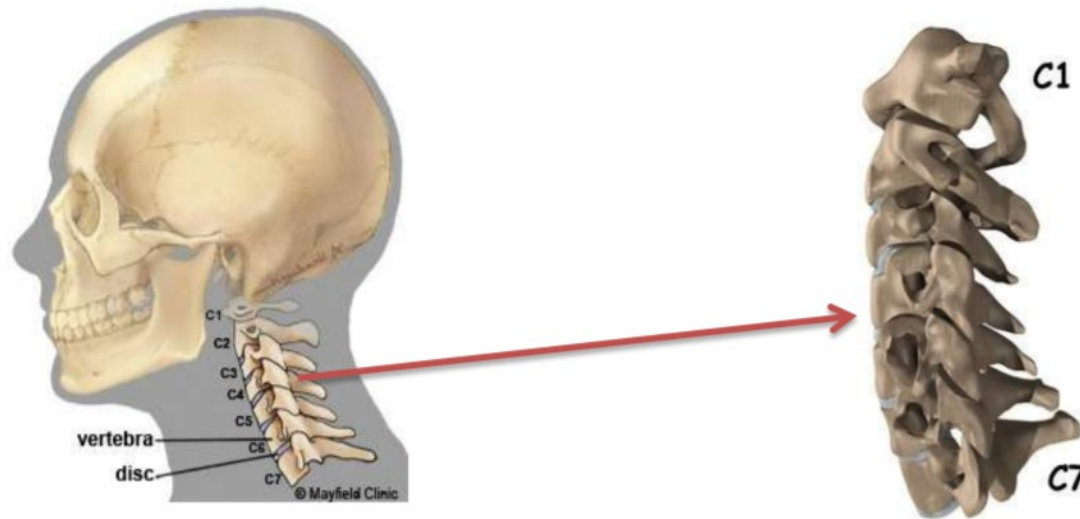
# Mobility of the Spine

- spine's range of motion (ROM) is done by:
  - ratio between the relative height of the disc and the corpus vertebrae
  - the shape of facies articulares of intervertebral joints
  - the shape and the tilt of processus spinosi





# Functional Anatomy of Cervical Spine



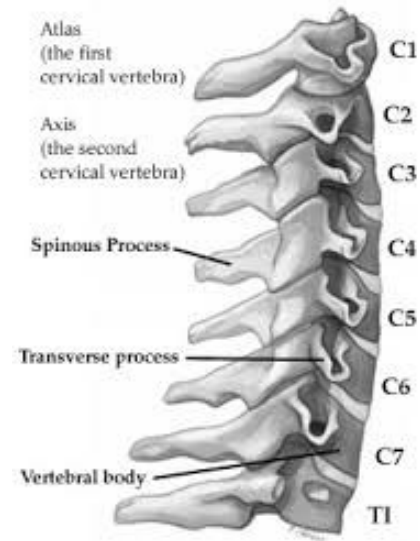
<http://thews-platform.eu/outputs/o3/2.%20Functional%20anatomy%20and%20bio-mechanics%20of%20cervical%20spine/Module%202%20UNIC.pdf>

# Cervical Spine

- ✘ made up of 7 vertebrae, the smallest one of the spinal column
- ✘ has a lordotic curve
- ✘ much more flexible than the rest of the spinal regions
- ✘ through the cervical spine is very flexible, it is also very much at risk for injury from strong, sudden movements

# Cervical Spine

- ✘ the C3 through C7 have a similar structure
- ✘ C1 (atlas) and C2 (axis) have a different structure
- ✘ C1 articulates with the occiput of the skull via atlanto-occipital joints (convex condyles of the occiput art. and concave superior art. facet of C1)
- ✘ between C1 and C2 there are three atlanto-axial articulations (two facet joints and pivot between dens of C2 and anterior arch of C1)



# Cervical Spine's Function

- supports the skull
- moves the spine
- protects the spinal cord

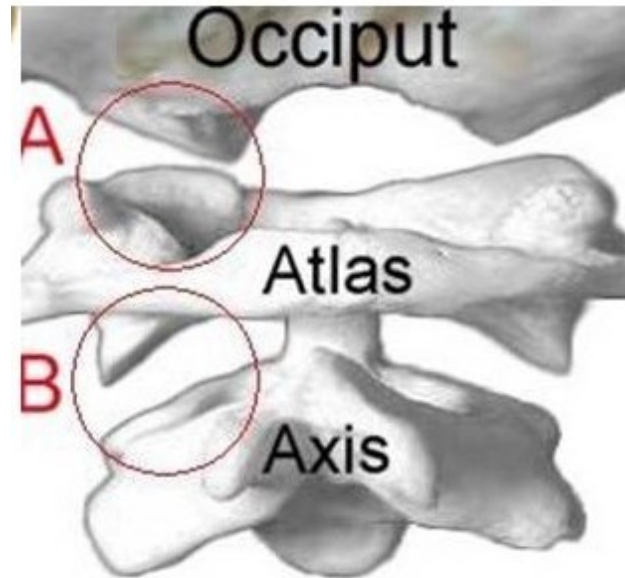


# Functional Anatomy of Cervical Spine

- two sectors:

- A. the upper cervical sector: occiput–atlas–axis –C3
- B. the lower cervical sector: C3-C4-C7-(Th1-Th 4)

# The Upper Cervical Sector



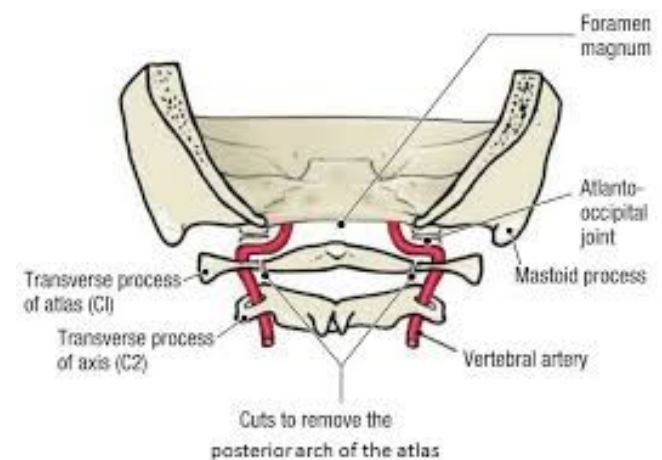
A: Atlanto-Occipital Joint

B: Atlanto-Axial Joint

# The Upper Cervical Sector

- ✘ formed of the cranial base with all joints of the skull, upper cervical sector and temporomandibular joints
- ✘ dominant and controlling part of the whole axial body system
- ✘ from the upper cervical sector and craniocervical communication are driven and activated all remaining parts of the axial system (precede eye movements)

# The Upper Cervical Sector

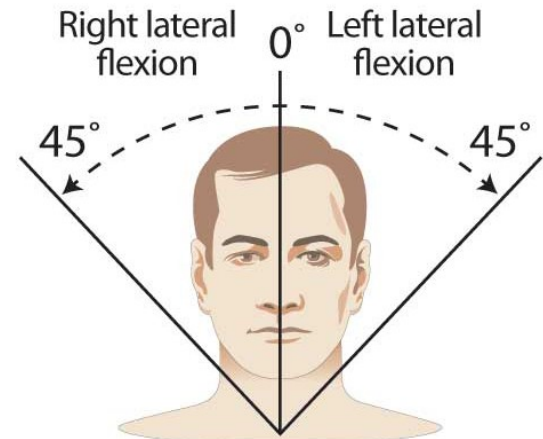
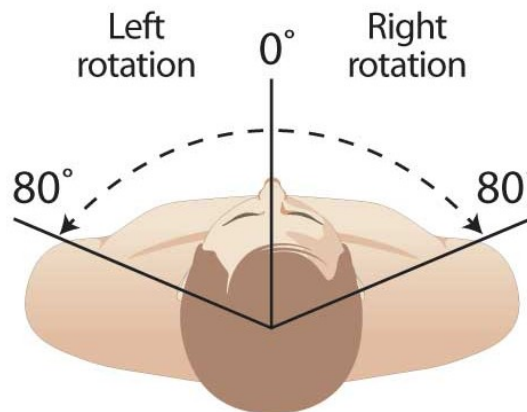
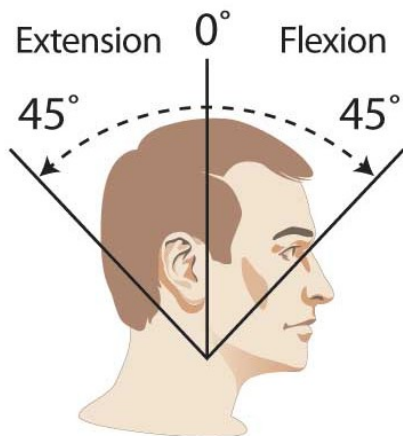


- ✘ indirectly related to certain structures of CNS participating in proceedings of motor functions, mainly to the vestibular nuclei in medulla oblongata and to the cerebellum
- ✘ the communication between the upper cervical spine and CNS is „supported“ by a. vertebralis going through processus transversales of cervical spine
- ✘ autonomic nerves in the arterial wall are irritated by its bending so the upper cervical spine through motions influences blood supply of certain structure in fossa cranii superior



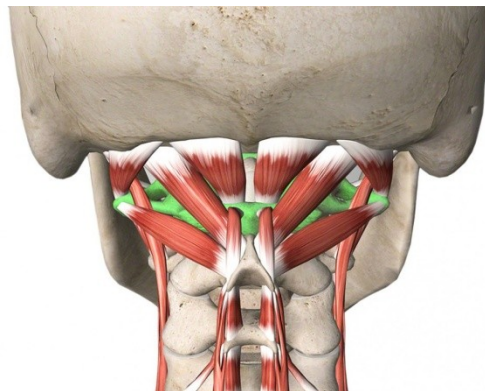
# The Cervical Spine's Range of Motion

- approximately 70° of **flexion**
- 50° of **extension**
- 30-45° of **lateral flexion** to both sides
- and up to 80° of **rotation** to both sides



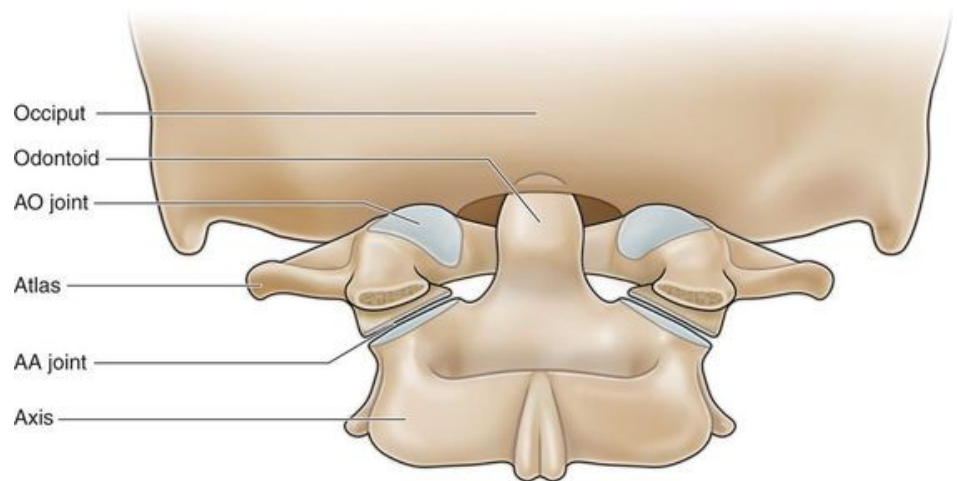
# Motions in The Upper Cervical Spine

The upper cervical spine is very important for postural function. If found incongruences between **sensoric afferent inputs** from the brain (visual, acoustic and vestibular one) and **proprioceptive afferent inputs** from the upper cervical spine (joint capsules, suboccipital muscles) then rise a **postural instability** and we can see postural uncertainty or even vertigo.



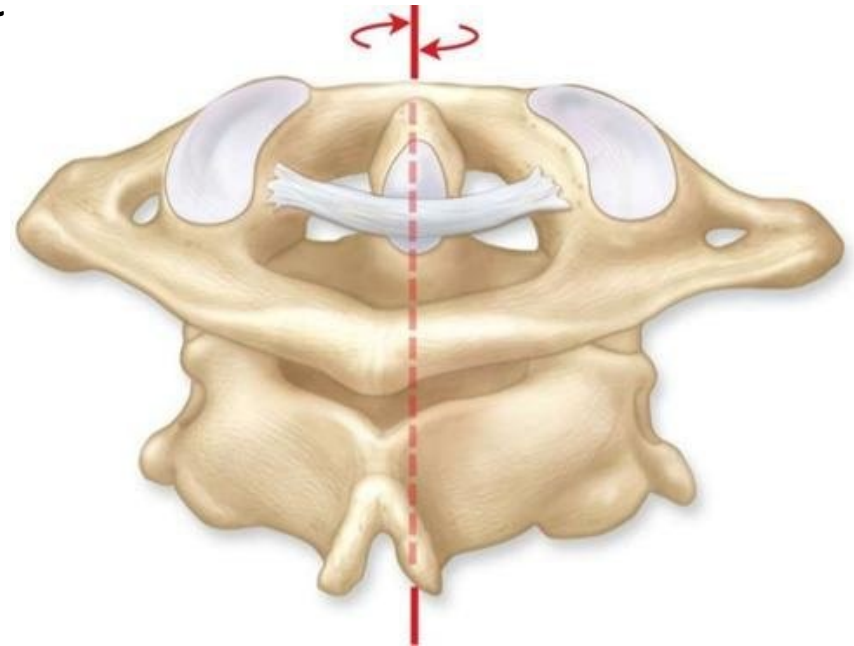
# Motions in The Upper Cervical Spine

- **atlanto-occipitalis joint:**
  - flexion–extension: up to  $15^{\circ}$
  - rotation: totally  $25^{\circ}$
  - lateral flexion: up to  $8^{\circ}$



# Motions in The Upper Cervical Spine

- **atlanto-axial joint:**
  - flexion-extension: up to 15°
  - rotation: up to 25-40°
  - lateral flexion: insignificant



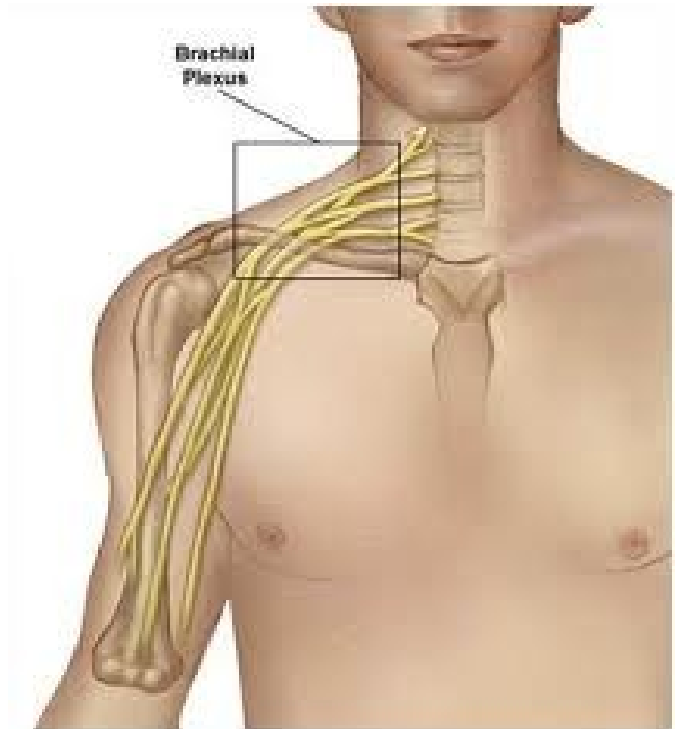
# The Lower Cervical Spine

- is directly related to the function and innervation of shoulder girdles and upper extremities (plexus brachialis), respiratory muscles (mm. intercostales, diaphragma), vascularization of spinal cord and due to spinal nerves even to autonomic innervation of many organs



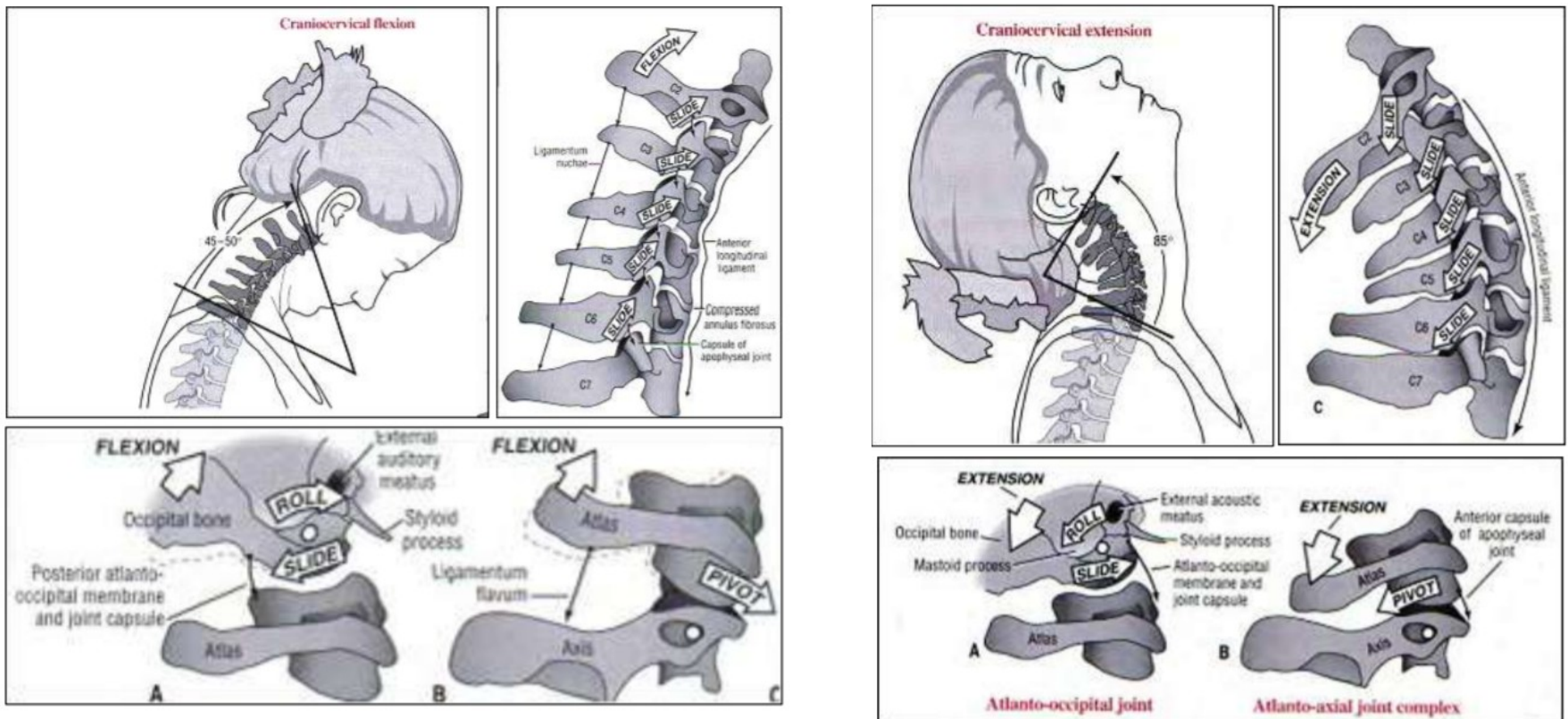
# The Lower Cervical Spine

- ✘ **locus minoris resistentiae** is C3 and C5/6, thus crossover segments of differently mobile axial sectors
- ✘ the cervico-thoracical sector is mechanically one of the most overloaded parts, disorders appearing in this sector are called **cervico-brachial syndrome**



# Motions in The Lower Cervical Spine

Flexion and extension (up to 100°)

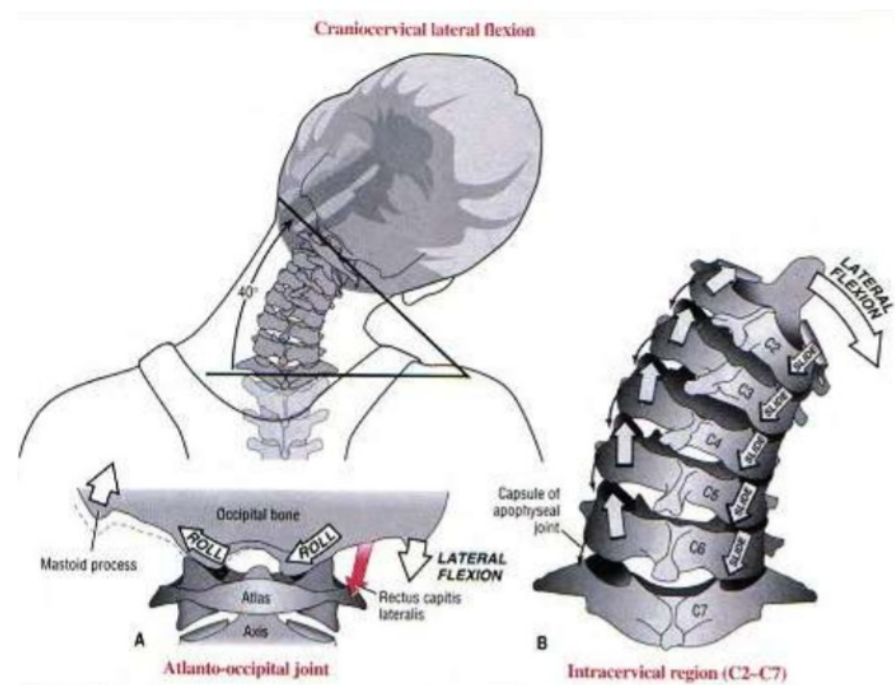
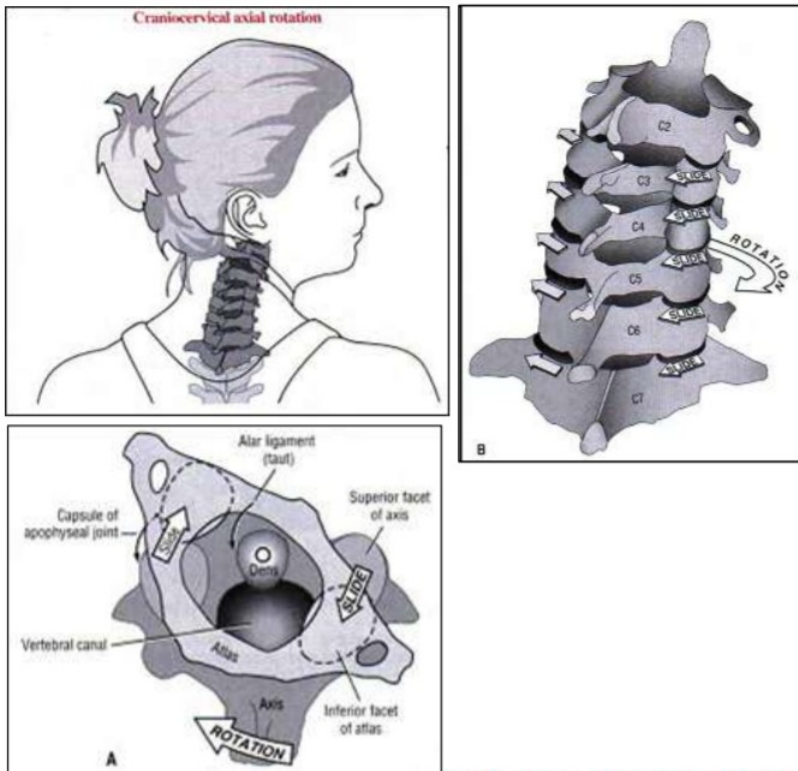




# Motions in The Lower Cervical Spine

Rotation (45°)

Lateral flexion (30°)





# The Most Common Vertebrogenic Disorders in Cervical Spine



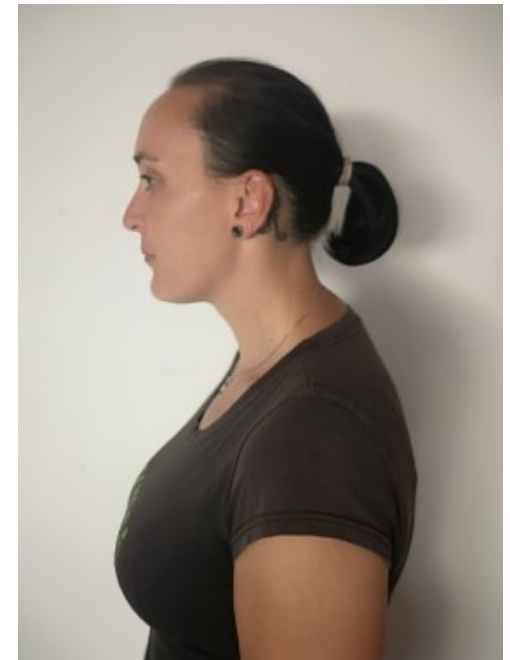
# Acute Blockade of Cervical spine

- ✘ **cause:** incorrect and tensed positions of spine, a vehement movement of neck and head, ...
- ✘ **manifestations:** antalgic posture of head in lateral flexion and rotation, neck pain (usually unilateral) radiating to the back of the neck (nape)
- ✘ active or passive **movements increase the pain**
- ✘ sometimes can be found **vegetative manifestation** (e.g. vomiting)
- ✘ **X-ray:** straightened cervical lordosis



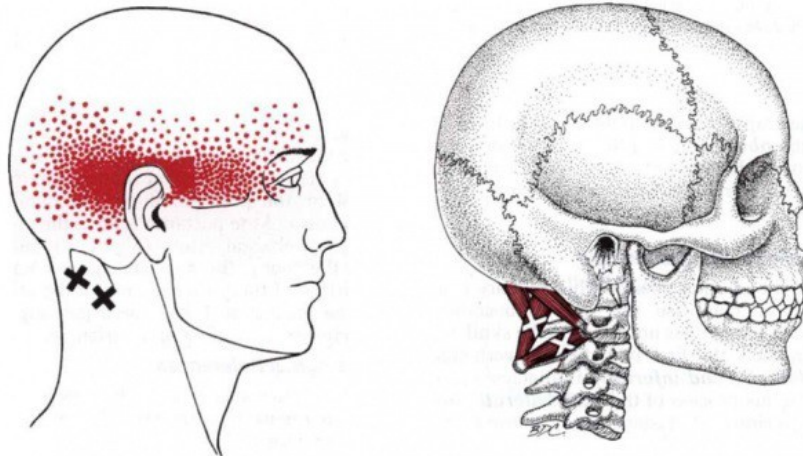
# Chronic Cervical Back Pain

- ✘ dull and persistent neck pain radiating to the neck and shoulders
- ✘ poor posture, muscles imbalance
- ✘ limited motions of cervical spine
- ✘ X-ray: often found degenerative changes – spondylosis, spondylarthrosis etc.



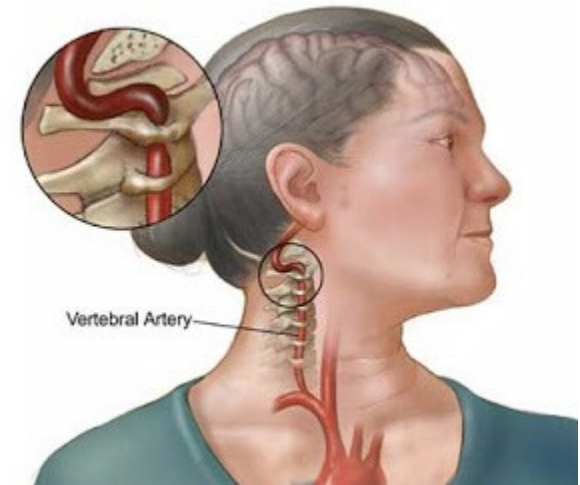
# Cervico-Cranial Syndrome

- headache, usually unilateral, paroxysmal
- blockade of AO joints and upper cervical spine
- psychic and hormonal influences



# Cervico-Vestibular Syndrome (Cervical Vertigo)

- ✘ cervical blockade connected with restriction of blood circulation in a. vertebralis causes the vertigo dependent on head position
- ✘ headache
- ✘ objectively: symptoms of vestibular syndrome (vertigo, nausea, vomiting, nystagmus)
- ✘ often occurs at elderly people with arteriosclerosis of brain vessels worsening by head extension and rotation



# Cervico-Brachial Syndrome



- ✘ **neck pain** radiating into the upper extremity, the most painful is shoulder and arm, no signs of radicular syndrome
- ✘ **neurological disorder** like tingling, sensory disturbance etc. can be present
- ✘ **causes:** blockade of the lower cervical spine, muscle disorders (many of the muscles of the upper portion of the trunk are mainly supplied by the cervical nerve roots and are often affected in cervical syndromes)

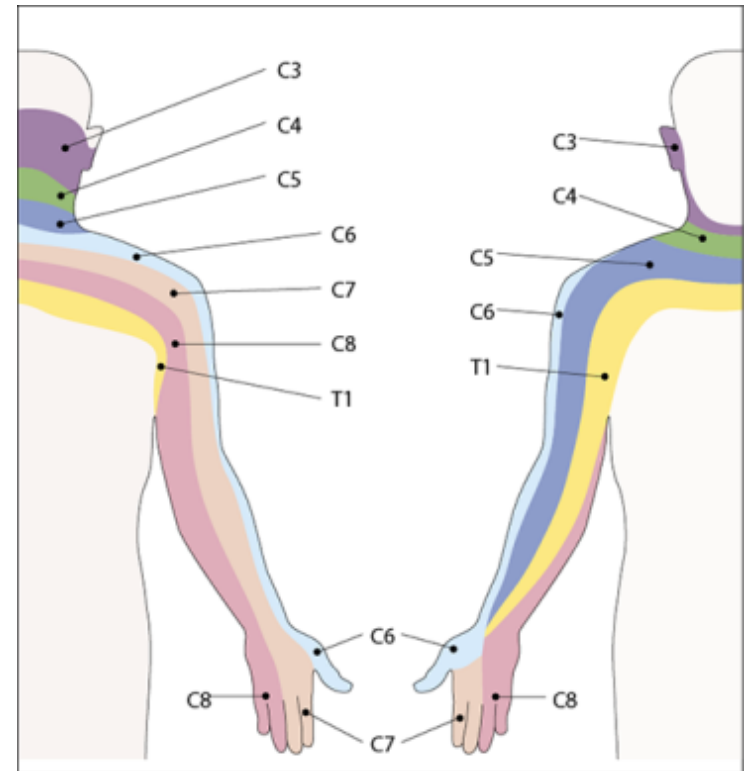
# Cervico-Brachial Syndrome

- **etiology:** the occupation of most patients is manual work with continuous, repetitive tasks like computer work, writing, manipulating or moving objects and lifting or overhead work. Tasks that require holding the same neck position for a long period are provocative factors of the symptoms



# Radicular Syndrome

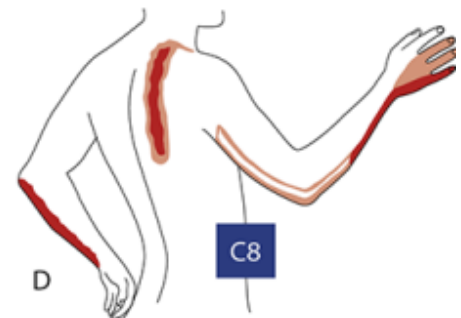
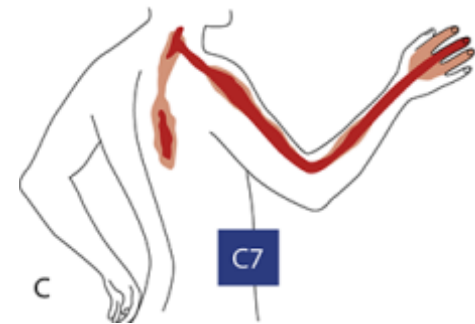
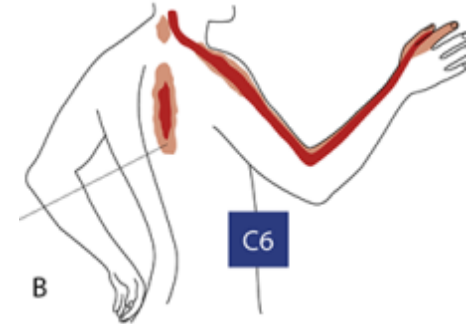
- ✘ burning pain in upper extremity, in relevant dermatome, radiating into the fingers
- ✘ hyporeflexia, muscle weakness, hypoesthesia in relevant dermatome
- ✘ head extension and rotation to the painful side causes worsening





# Radicular Syndrome

- ✘ **radicular syndrome C6:** pain is radiating to big toe and index finger, hyporeflexia of radio-prone reflex
- ✘ **radicular syndrome C7:** pain is radiating to middle finger, hyporeflexia of tricipital reflex, weaker elbow extension
- ✘ **radicular syndrome C8:** pain is radiating to ring finger and little finger, hyporeflexia of flexor fingers reflex, weaker finger's flexion



# Functional disorders of the musculoskeletal system

- Means any disorders of function of joints, muscles, nerves, other soft tissues and organs, when the structural cause is not the actual (primary) reason of the clinical symptoms
- The functional disorder is the sign of incorrect controlling function

# Functional disorders of the musculoskeletal system

The clinical symptoms manifest at **3 systemic levels:**

- **A. Muscles:** muscular imbalance (shortened vs. weak muscles)
- **B. Central regulation:** uncorrect muscle patterns
- **C. Joints:** limitation of joint movement vs. hypermobility

# Functional disorders of the musculoskeletal system

In the development of the functional disorders the main impact has the body attitude and the movement regime:

- not enough motion
- overloading/stereotypical load (muscular imbalances)
- psychological stress

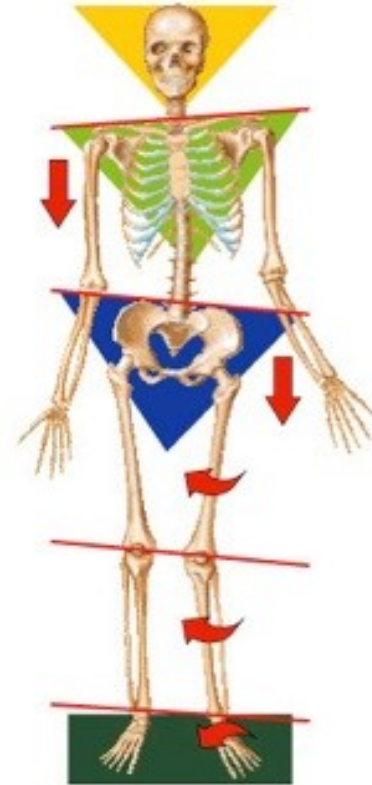
Functional disorders are often the cause of **the pain** and if left untreated it can have **structural consequences**

# Examination of Cervical Spine

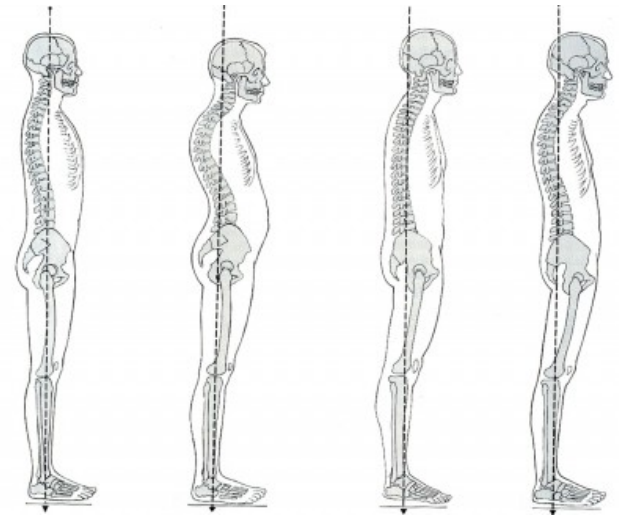
- medical history
- static and dynamic examinations (observation)
- local examination (palpation)
- assesment of muscles
- motion patterns
- neurological examination

# Medical History

- history of present illness
  - pain: localisation, quality, duration, alleviating X aggravating factors (positions, movements), etc.
  - sensitivity (hypo-, hyper-, paresthesia)
  - movement disorders
- patients medical history (illnesses, surgeries)
- job, sports, habits
- remedies, addictions



# Aspection



- holding of the head (posture)
- holding of C spine (in sagittal and frontal plane)
- contours of the muscles
- position of shoulder girdles, shoulder blades

# Palpation

- ✘ temperature, pain, mechanical features, ...
- ✘ skin – hyperalgetic zone (HAZ)
- ✘ subcutaneous – extensibility
- ✘ fascia – extensibility
- ✘ muscles – Trigger Point (TrP), Tender Point (TeP)
- ✘ joints – joint play (JP)



# Dynamic Examination

- ✘ active movements
  - ✘ passive movements
  - ✘ resistance movements
  - ✘ specific examinations
- 
- ✘ compare range of motion on both sides
  - ✘ hypomobility X hypermobility
  - ✘ pain

# Active movement assessment

(anteflexion, retroflexion, lateroflexion, rotation)



# Passive movement assessment

(anteflexion, retroflexion, lateroflexion, rotation)



# Resisted movement assessment

(anteflexion, retroflexion, lateroflexion, rotation)



# Assessment of particular cervical segments

(C0-C1, C1-C6, CTh) anteflexion, retroflexion, lateroflexion, rotation

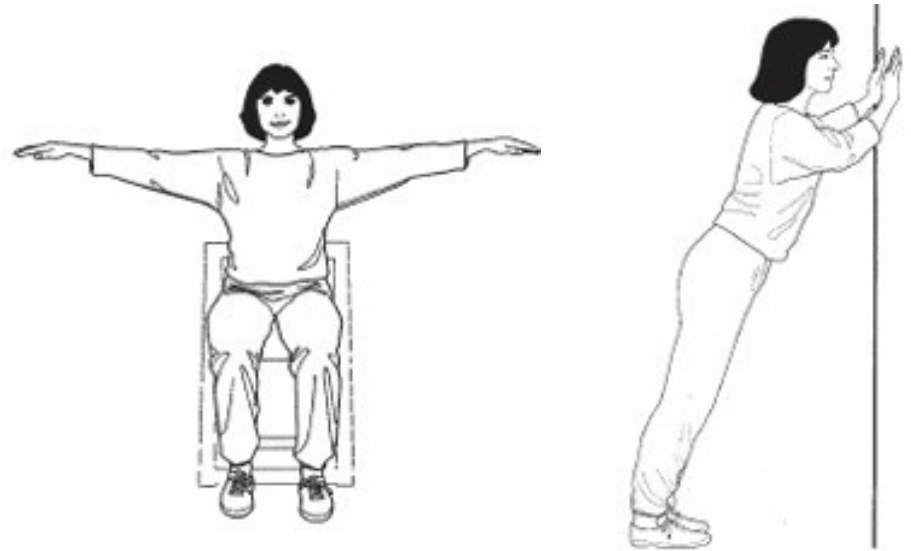


# Assesment of Muscles

- **assesment of muscle strength** (manual muscle testing – grading scale) – short neck flexors, middle and lower part of m. trapezius, mm. rhomboidei
- **assesment of muscle shortening** (flexibility) – upper part of m. trapezius, m. sternocleidomastoideus, m. levator scapulae, short neck extensors

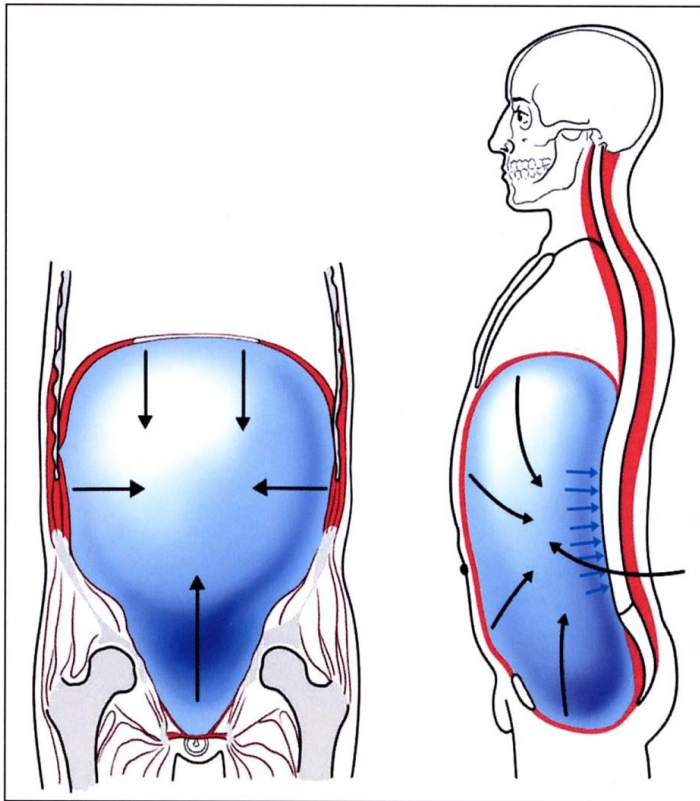
# Motion patterns assessment

- flexion of neck
- shoulder abduction
- press-up
- breathing pattern
- gait

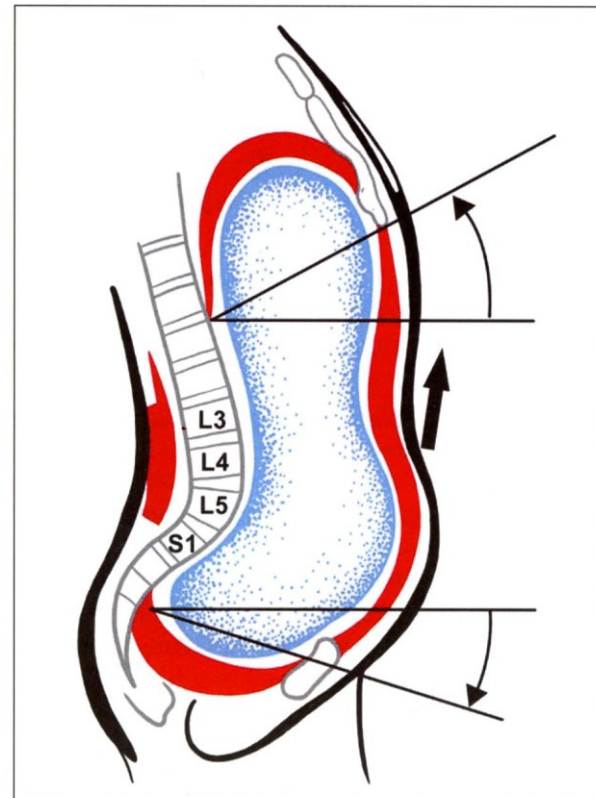


# Motion patterns assessment

- Breathing pattern (deep stabilisation system)



Physiology

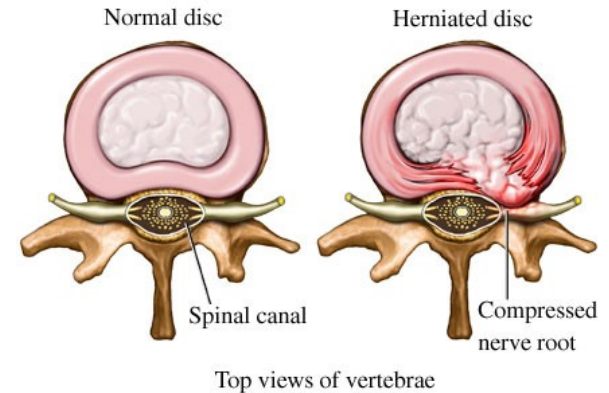


Pathology



# Neurological examination

- motor examination
- reflexes
- sensory assesment
- provocative maneuvers (test of cervical traction, cervical compression)



# The Basic Physiotherapeutic Measures in Cervical Spine

- **immobilization**

- cervical collar
- resting
- staying in analgetic position



- **kinesiotaping**



- **preventive and routine measures, Back school**

# The Basic Physiotherapeutic Measures in Cervical Spine

## Manual treatment

- exteroceptive stimulation
- massage
- soft tissue techniques
- joint mobilization, joint manipulation



# Soft tissue techniques

(assessment and treatment of skin, subcutaneous tissues, fascias)



# Stretching of shortened muscles (PIR)

(deep neck flexors, upper trapezius, levator scapulae)



# Stretching of shortened muscles (PIR)

(mm. scaleni, m. sternocleidomastoideus)





# Cervical traction



# Cervical spine mobilisation





# The Basic Physiotherapeutic Measures in Cervical Spine

## ✘ Therapeutic exercise to:

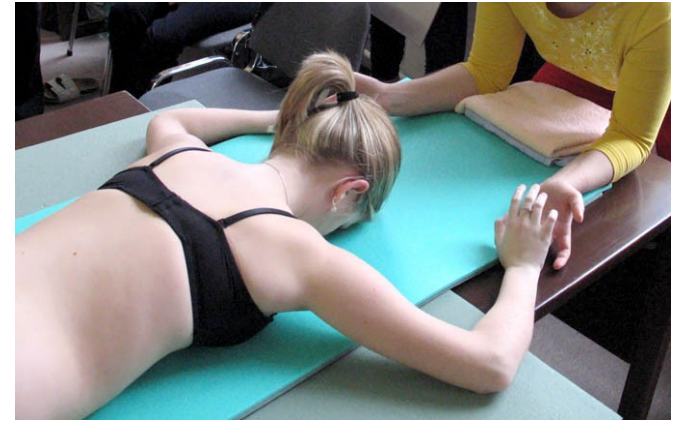
+ influence muscle imbalance

+ learn of good motion patterns

+ activation of deep stabilization system of the spine

+ stretching exercises

+ Vojta's principle, McKenzie method, SMS, Brunkow...



# Therapeutic exercises

## Deep stabilisation system activation



Therapeutic exercises

# Brunkow method



Therapeutic exercises

# McKenzie method



Therapeutic exercises

# Vojta method





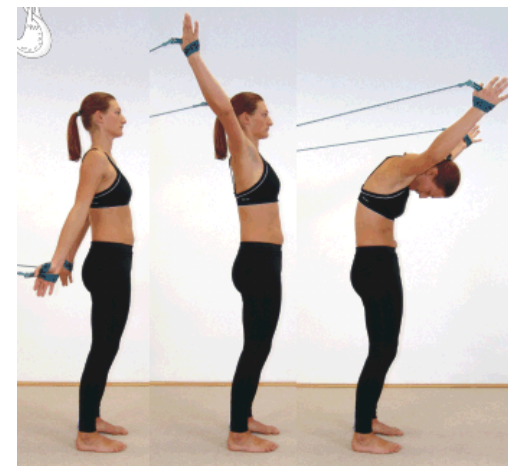
Therapeutic exercises

# Senzomotoric stimulation

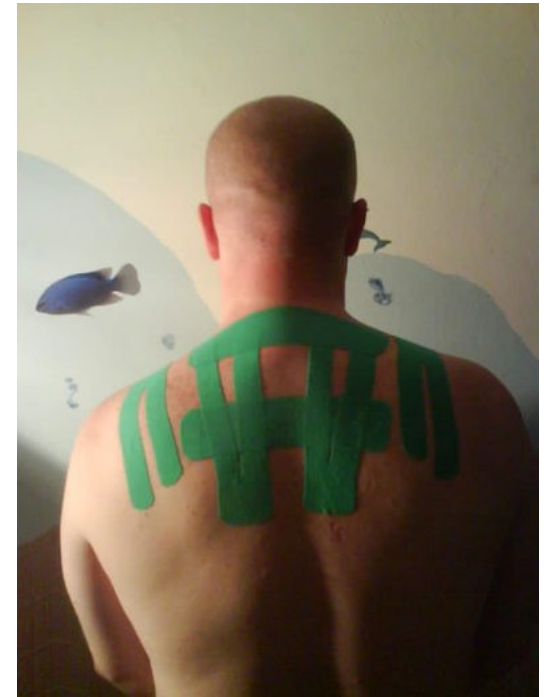


# Therapeutic exercises

## SM system



# Kinesiotaping





# The Basic Physiotherapeutic Measures in Cervical Spine

## **✘ physical therapy modalities**

+ electrotherapy

+ magnetic therapy

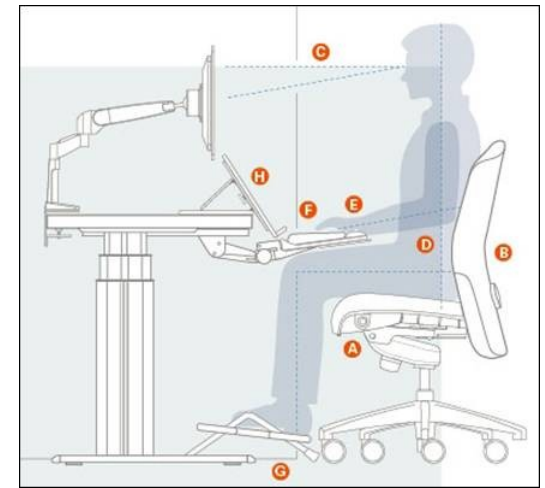
+ thermotherapy

+ hydrotherapy

+ mechanotherapy

## **✘ spa treatment (balneotherapy)**

# Back School



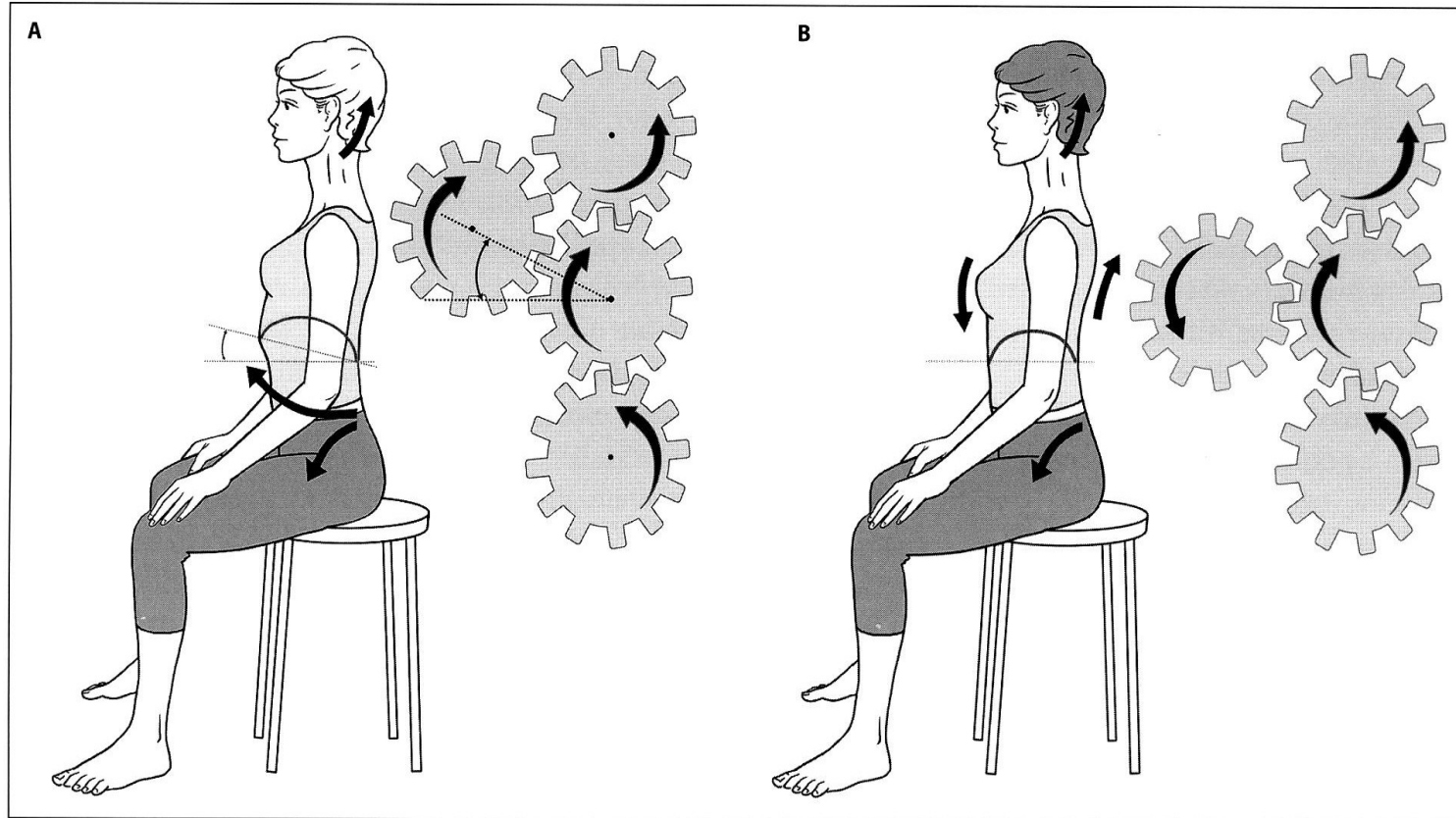
„A back school is an educational program that teaches people practical information about back care, posture, body mechanics, back exercises, and how to prevent long-term back problems. Back school gives you the tools for self-care, which may improve how well you manage back pain.“

# Back School



# Correct sitting position

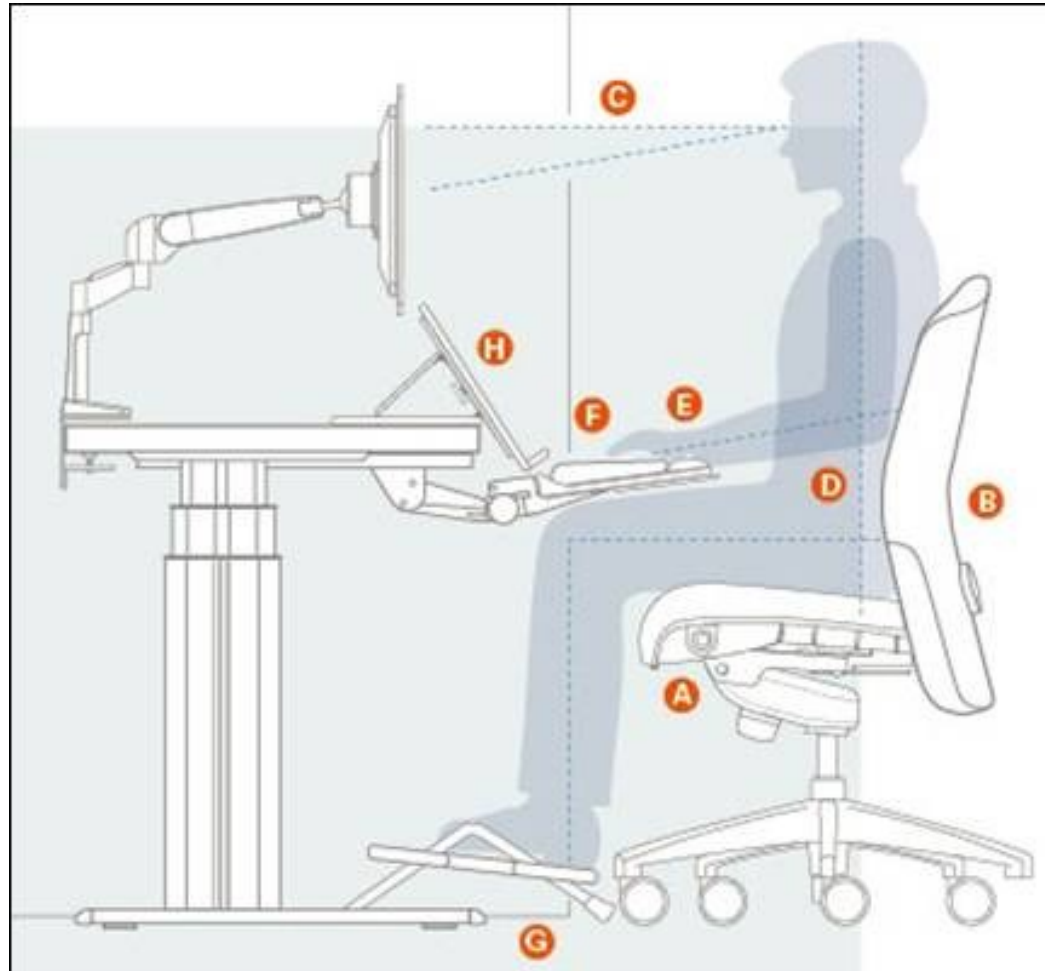
(Brügger Kolář)



- Brügger concept

- Kolář concept

# Correct sitting position



# Ergonomics

- ✘ ergonomic dental chair
- ✘ ergonomic dental tools etc.



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Thank you for your attention

