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Disorders of consciousness

Jan Kočica, Blanka Adamová

Consciousness disorders

- Consciousness is **awareness of the internal and external world** = a state in which the individual is **fully aware of him/herself** and his/her surroundings and is **able to act according to his/her free will** and **respond adequately** to external and internal stimuli.

CONSCIOUSNESS
VIGILANCE (vigility, wakefulness)
The ability to **adequately respond** to stimuli from an external environment.
LUCIDITY (awareness)
The ability to be **aware of one's own existence** in the waking state and to **correctly interpret perceptions** from one's surroundings. Vigility is therefore a condition of lucidity.

Consciousness disorders – physiology

- To maintain consciousness, proper **reticular formation** (RF) of the **brainstem** and its **connection** **with diencephalic structures** (thalamus, hypothalamus) and **cerebral cortex** (temporo-parieto-occipital border and frontal medial cortex) is necessary.
  - The **ascending reticular activation system** (ARAS), sometimes also described as RAS or extrathalamic reticular control modulatory system, functions as an afferent system for the **control of predominantly alertness**.
  - RF is a group of interconnected neurons throughout the brainstem (from the midbrain to the medulla oblongata). Continuing in the spinal cord like the reticulospinal tract.

Consciousness disorders – pathophysiology

- However, **extracerebral/systemic causes are more common** (such as hypo/hyperglycaemia, intoxication, hypotension or any conditions generally leading to decreased brain perfusion).
- **For impaired consciousness** as part of a structural (focal) impairment of the brain, the patient must have:
  - **Brain stem lesion** or
  - affected **both** **hemispheres**,
- Unilateral hemispheric lesions **do not lead to a disorder of consciousness** unless the other hemisphere is affected at the same time/secondarily (e.g. by overpressure of midline structures due to oedema).

Consciousness disorders – basic concept

CONSCIOUSNESS
VIGILANCE (vigility, wakefulness) – **QUANTITATIVE** CONSCIOUSNESS DISORDERS
Inability (affects arousal) to **respond adequately** to a stimuli of an external environment.
LETHARGY (DROESINNESS)
STUPOR
COMA

Consciousness disorders – basic concept

CONSCIOUSNESS

VIGILANCE (vigility, wakefulness) – **QUANTITATIVE** CONSCIOUSNESS DISORDERS

LETHARGY (DROESINNESS)

There is no spontaneous level of vigilance, **increased drowsiness**. Patient can be **awakened by addressing or touching** – reacts with latency/slowly, inaccurately. If the impulse to maintain vigilance disappears, the patient falls asleep. Somnolence can be caused, for example, by sleep deprivation.

STUPOR

No spontaneous level of vigiliance. The patient can not be awakened addressing, but only **by strong stimulation** (algic/nociceptive stimulus). It usually answers in one word or makes incomprehensible sounds.

COMA

Does **not respond to stimuli at all** (deep coma) or **responds non-specifically** / very limited / imperfectly to strong algic/nociceptive stimulation.

Consciousness disorders – basic concept

CONSCIOUSNESS

LUCIDITY (awareness) – **QUALITATIVE** CONSCIOUSNESS DISORDERS

Inability to be **aware of one's own existence** and to correctly interpret perceptions from one's surroundings. Vigility is a condition of lucidity.

DELIRIUM

Non-specific response to various somatic disorders (e.g., metabolic or infectious) or intoxication. Organic mental disorder.

- **Sudden onset** (max. in days) and **fluctuating course** (often with a sleep-wake cycle disorder).
- **Attention and perception disorder** (disorientation by time, place and person) and **acute cognitive dysfunction** (usually all domains - i.e., memory, attention, concentration, executives (planning, organization, working memory), speech, spatial orientation) dominate.
- Often **accompanied by psychiatric manifestations** (restlessness, agitation, hallucinations, delusions and aggression). It may be accompanied by motor restlessness (e.g. tremor), sweating and tachycardia.

Consciousness disorders – basic concept

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Consciousness – physical examination

– What questions should a physician ask when examining a patient with impaired consciousness?

1) What is the **severity and character** of the disorder of consciousness?

2) Where can be **an expected location** of the disability?

3) What is **the cause** of the disability?

How serious is the situation?

Consciousness – physical examination

1) What is the **severity and character** of the disorder of consciousness?

- Examination usually takes place on emergency department with little anamnestic data (paramedic‘s report, relatives, witnesses).
- **Glasgow Coma Scale** (GCS) - a simple reproducible and fast method to assess the level of consciousness (quantitative impairment of consciousness, vigility).
  - Widely used scale to assess the initial severity of traumatic brain injury.

Glasgow Coma Scale (GCS)

BEST EYE RESPONSE (E)	
Spontaneously.	+ 4 body
To **verbal** command.	+ 3 body
To **pain**.	+ 2 body
No eye opening.	+ 1 bod

BEST VERBAL RESPONSE (V)	
Oriented.	+ 5 bodů
Confused.	+ 4 body
Inappropriate words.	+ 3 body
Incomprehensible sounds.	+ 2 body
No verbal response.	+ 1 bod

BEST MOTOR RESPONSE (M)	
Obeys commands.	+ 6 bodů
Localizes **pain.**	+ 5 bodů
Withdrawal from pain.	+ 4 body
Flexion to pain (decortication).	+ 3 body
Extension to pain (decerebration).	+ 2 body
No motor response.	+ 1 bod

Coma	
8 or less	Severe
9 – 12	Medium
13 +	Light


Points:
1
2
3
4
5
6
Best motor response
No motor response
Extends to pain (decerebrate)
Flexes to pain (decorticate)
Withdraw from pain
Localize to pain
Obeys commands
Best verbal response
Hello?
No verbal response
What is your name?
Cthulhu!
Incomprehensible sounds
What year is it?
Narwhal bacon!
Inappropriate words
Where are you?
The Colosseum!
Confused
Where are you?
The hospital!
Oriented
Eye opening
"four eyes"
No opening
Pain
Open your eyes!
Verbal Command
Spontaneous
Remember, even a toaster has a GCS of 3!

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Consciousness – physical examination

1) What is the **severity and character** of the disorder of consciousness?

- Evaluation of **lucidity/awareness**:
  - We usually evaluate the orientation of a patient by person, place and time.
  - *What is your name? What is the day today? What is the current year? Where are we? In which city are we? Try to describe what I'm wearing right now. Point to a nurse – Do you know what her/his job is?*
- If the patient responds appropriately and correctly, **only then can a valid anamnesis be taken.**
- If the patient has a qualitative disorder of consciousness, we must **not forget to record this fact in the documentation** when taking the anamnesis!

Consciousness – examination record

1) What is the **severity and character** of the disorder of consciousness?

Normal findings:

Objective examination:

Patient conscious/vigil, oriented, cooperating,…

Lucid, cooperating,…

Pathological findings:

Objective examination:

Deep stupor, GCS 9 (E2V3M4),…

Consciousness – physical examination

2) Where can be an expected **location of the disability**?

- Evaluation of **vital functions** (respiration, blood pressure, heart activity)
- Blood samples are usually taken in parallel (incl. Acid-base balance or toxicology)

ASPECTION

- Overall appearance? Posture? Spontaneous movements? Response to external stimuli? Asymmetry of a limb movement? Involuntary movements?

SOMATIC EXAMINATION

- It is usually performed in parallel by an emergency physician.
- Signs of trauma, bleeding, examination of the heart, abdomen,…

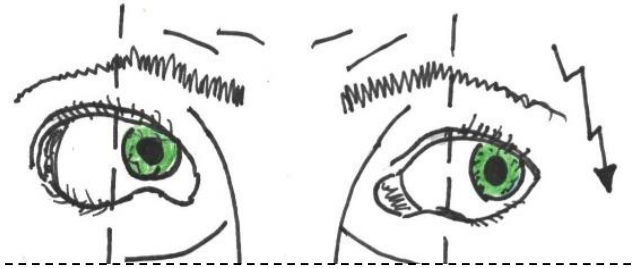
Consciousness – physical examination

2) Where can be an expected **location of the disability**?

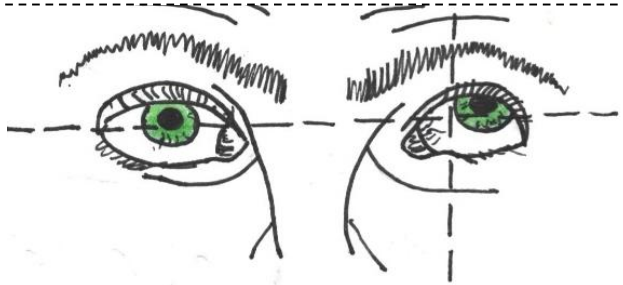
NEUROLOGICAL EXAMINATION

- Assessment of a **level** of consciousness disorder.
- Determination of whether the **brain stem functions are intact**.
- Examination of eye symptoms (position of bulbs, movements, pupillary reactions).
- Muscle tone test and examination of focal symptoms.
- The nature of breathing.

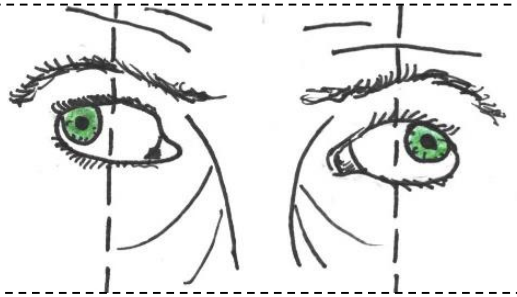
Consciousness – physical examination



Conjugated left deviation of bulbs – both bulbs turn to „see the leasion“ (destructive lesion).



Skew deviation – Abnormal horizontal-torsional position of the left bulb.



Divergent position of bulbs. Often accompanies severe impairment of consciousness.

EYEBALLS POSITION

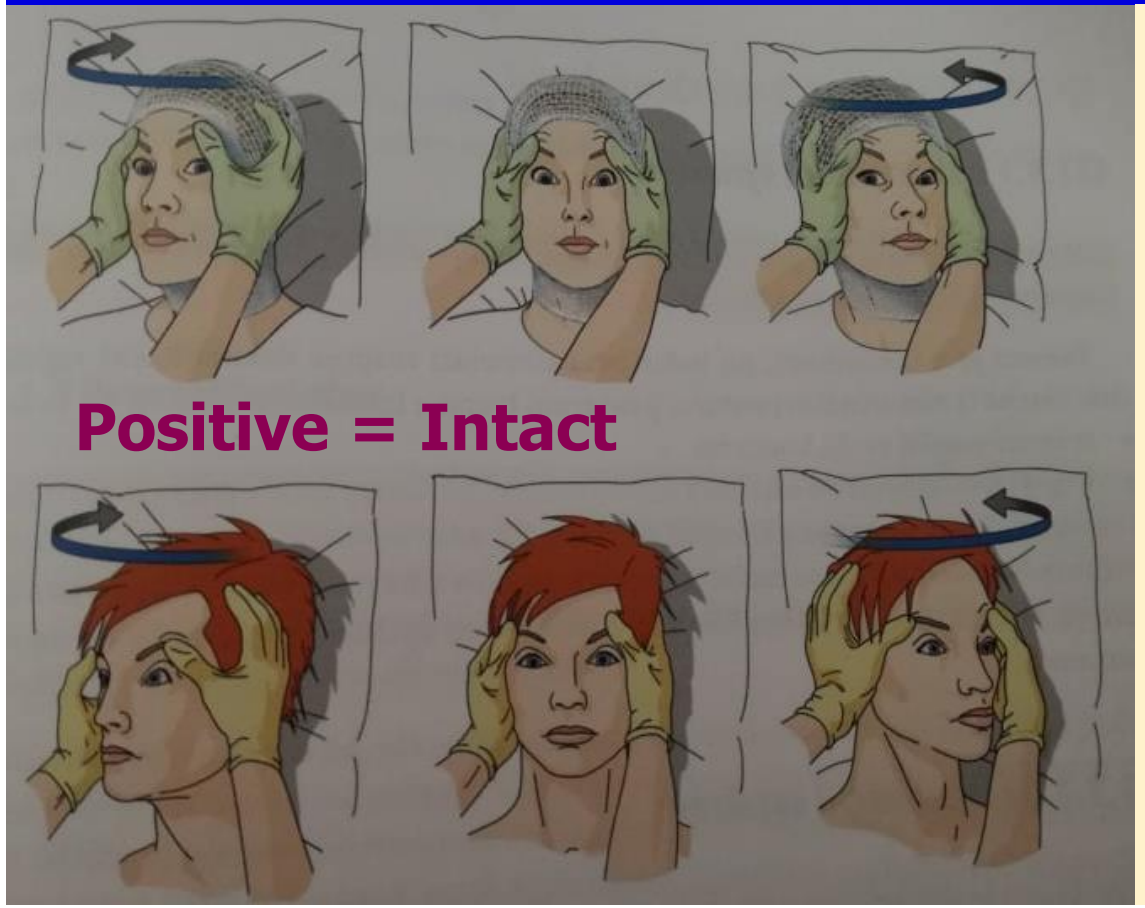
- Are they in an asymmetrical position?
- Wandering movements of bulbs?

EYEBALLS MOVEMENT

- Spontaneous movements?
- Are oculomotor nerves intact?

Consciousness – physical examination

EYEBALLS MOVEMENT - OCULOCEFALIC REFLEX



OCULOCEFALIC REFLEX (horizontal/vertical)

- The **positive** is manifested by conjugate deviation/twisting of both **eyeballs to the <u>opposite</u> direction** to the position of the head.
- If positive, **integrity of the pons Varoli** (if horizontal) is maintained.
- The manoeuvre also tests the intactness of the oculomotor nerves, vestibular nuclei and *fasciculus longitudinalis medialis* (FLM).

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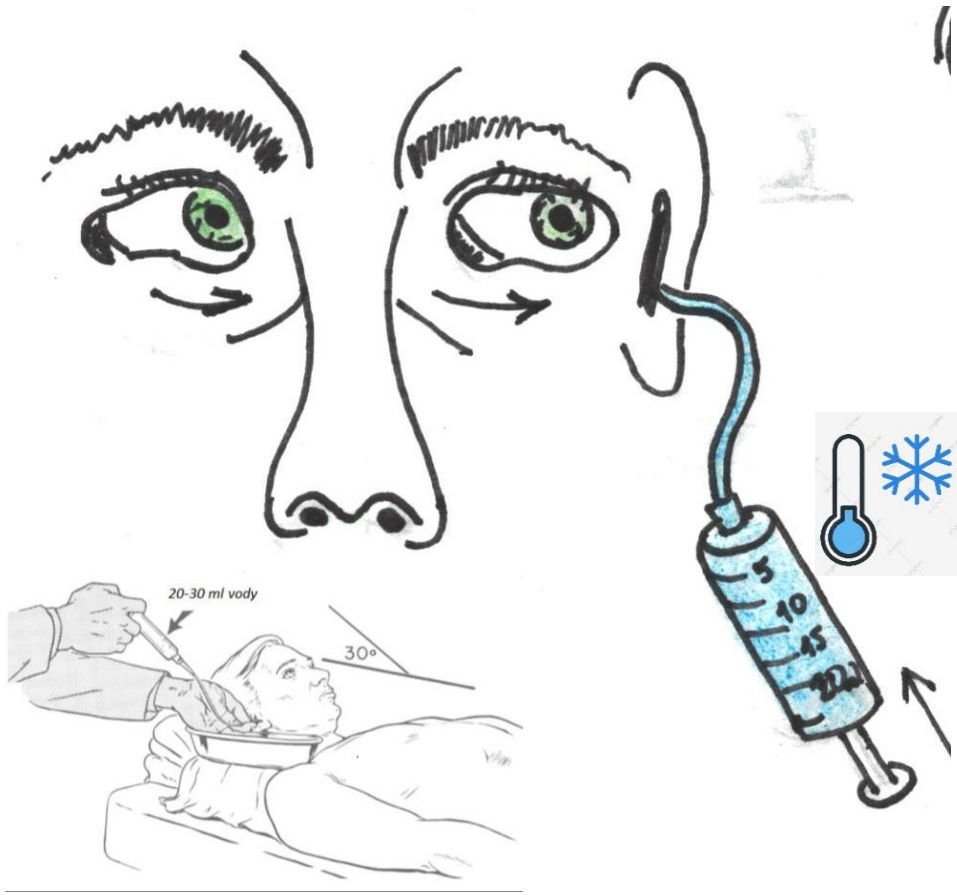
Consciousness – physical examination

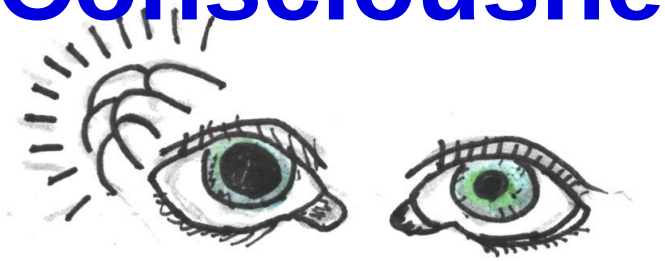
EYEBALLS MOVEMENT – OCULOCALORIC REFLEX



OCULOCALORIC REFLEX

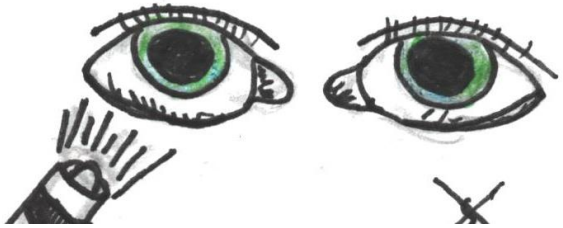
- 10-15 ml of physiological solution is applied to the ear canal, while the reflex is equipped with a **deviation of bulbs to the application side**.
  - In general, **hot water** (room temperature) leads to the deviation of the **bulbs to the opposite side** and **cold** water **to the application side**.
- If the movement is only with one bulb, then it is still true that there is probably a brain stem lesion.

Consciousness – physical examination



Incomplete lesions of the **oculomotor nerve (III) - Dilated** (mydriatic) **fixed** (non-reactive) **pupil on the side of the lesion -** can be caused by swelling on the side of the lesion or the temporal conus.

Bilateral myotic (narrowed) **reactive** (unfixed) **pupils.**
They may be part of **opiate intoxication** or **bilateral diencephalic lesions** (sympathetic) at the level of the thalamus and hypothalamus.



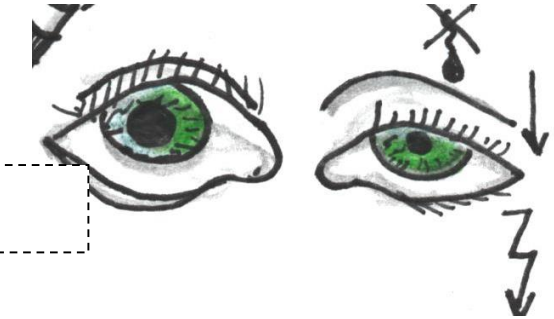
Bilaterally dilated (mydriatic) fixed (areaactive).
They can be **severe hypoxemia** or **signs of death**.

EYE SLIT

- It is necessary to distinguish whether it is **ptosis** of the eyelid or **paresis of the facial nerve** (watch wrinkles, lagophthalmus).

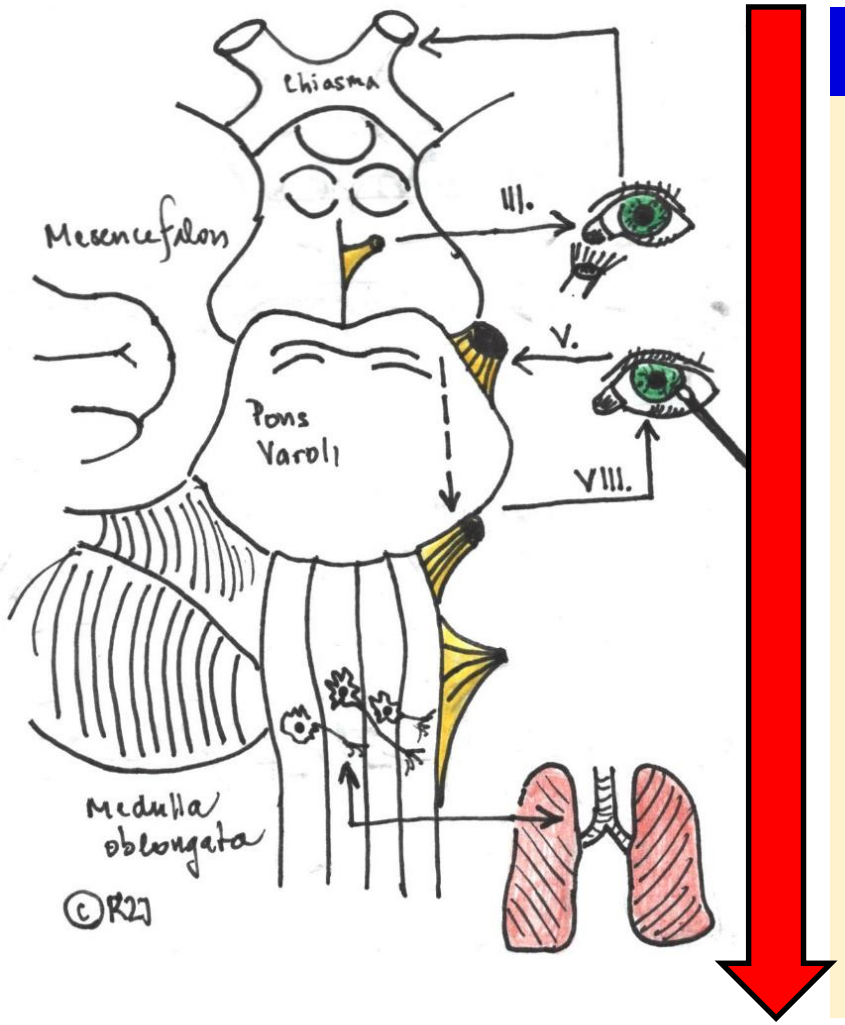
PUPILLAR REFLEXES

- Evaluate symmetry, **size** (miosis/mydriasis), shape, symmetry (anisocoria) and photoreaction.



Normal or myotic responding pupil together with **semiptosis** of the eyelid and possible **anhidrosis of the forehead.**
Part of the so-called **Horner's syndrome** (eg carotid dissection).

Consciousness – physical examination



BRAINSTEM REFLEXES

- They correspond to **certain levels of the brainstem.**
- **NAZOPALPEBRAL REFLEX**
  (Diencephalo-mesencephalic junction)
  = Hammering between the eyelids (at the level of the eyebrows, glabella) leads to bilateral blinking (syn. Fronto-orbicular). When repeated, it extinguishes reflexively!

- **OCULOCEFALIC VERTICAL REFLEX**
  (Diencephalo-mesencephalic junction)

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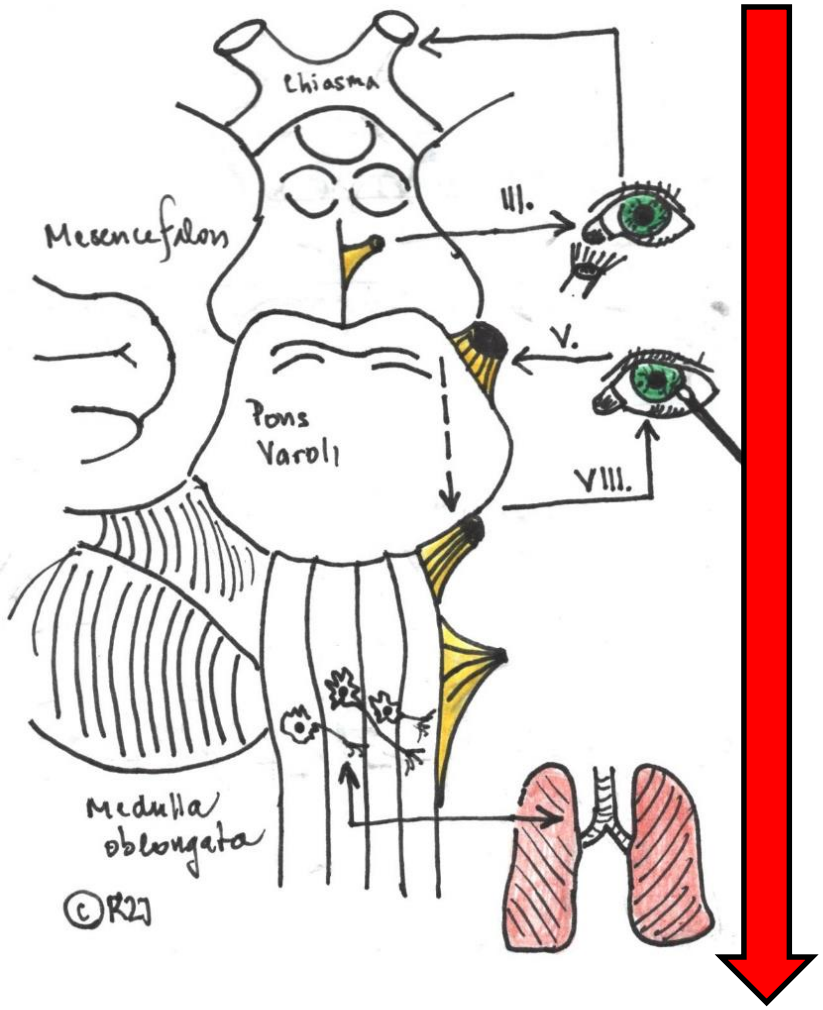
Consciousness – physical examination

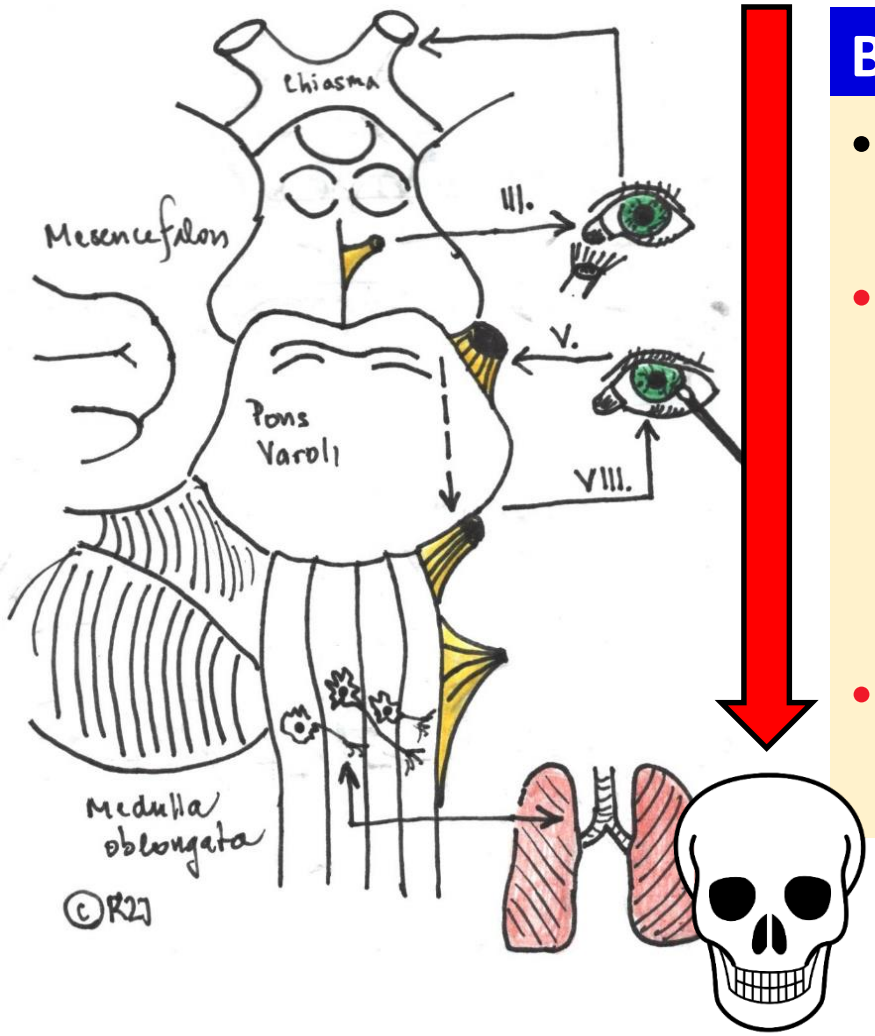


BRAINSTEM REFLEXES

- They correspond to **certain levels of the brainstem.**
- **PHOTOREACTION** (middle part of the mesencephalon)
  - Direct (leads to equilateral miosis)
  - Indirect (also contralateral miosis)

- **CORNAL REFLECTION** (pons Varoli, n. V, n. VII, n. III)
  = Touching on the edge of the cornea leads to blinking (straight to the same side and indirect to the other side). Disorder indicates a serious condition.

Consciousness – physical examination



BRAINSTEM REFLEXES

- **OCULOCEFALIC HORIZONTAL** (lower pons Varoli, n. VI)

- **OCULOCARDIAL** (lower pons - elongated spinal cord, n. V)
  = by pressing on bulbs with figers, we cause a decrease in heart rate (by at least 15BPM in the first 20 seconds).
  We perform it only in patients on the monitor, if it is possible, because with a reflex we can cause heart arrest in patients!

- **GAG A COUGHING REFLEX**
  = Cough when intubating or when handling kanyla.

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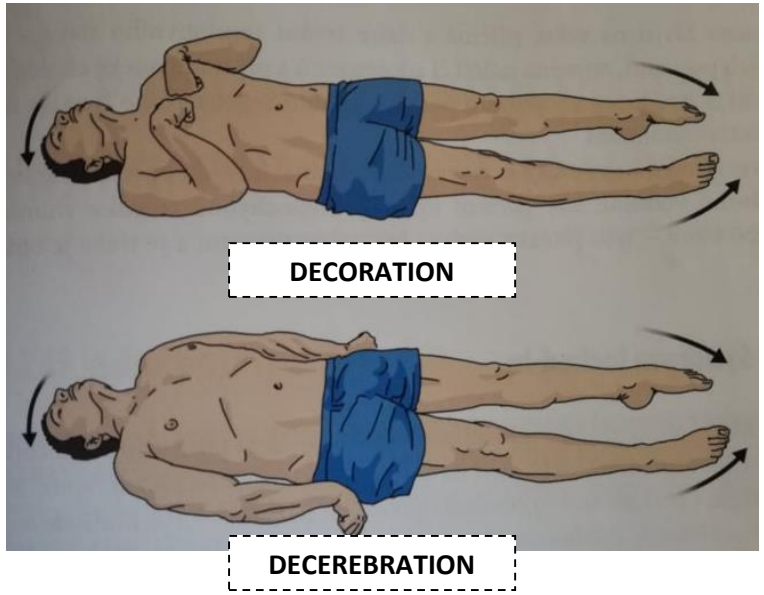
Consciousness – physical examination



MOVEMENT

DECORATION SYNDROME

- Disorders at the level of the thalamus and both cerebral hemispheres.
- Brainstem functions are **intact**.
- Unconsciousness + decortication rigidity (reaction to nociceptive stimulus)
  - Upper limb/s **flexion in elbows and wrists**.
  - Lower limb/s **extension in the knees and insteps**.

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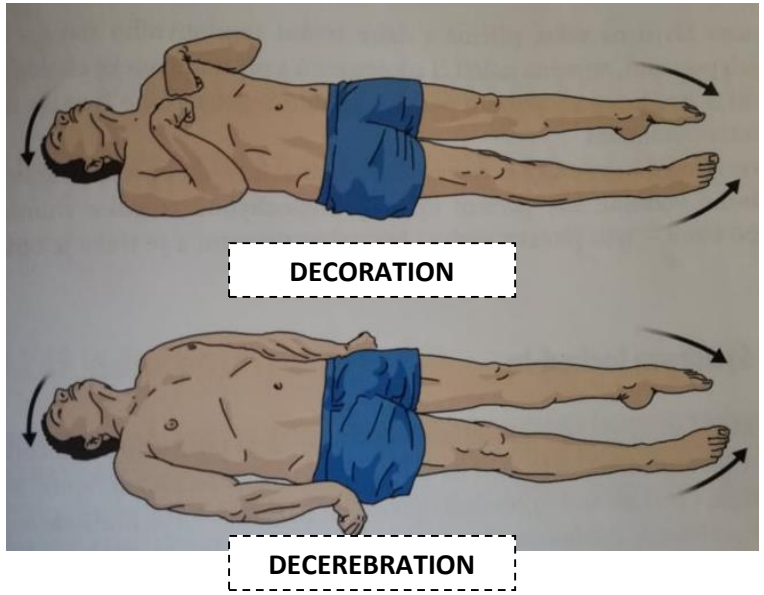
Consciousness – physical examination



MOVEMENT

DECEREBRATION SYNDROME

- Usually due to extensive **brainstem involvement** (especially herniation)
- Unconsciousness + decerebral rigidity
  - Upper limb/s **extension in the elbows, flexion with pronation in the wrist.**
  - Lower limb/s **extension in the knees and insteps.**

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Consciousness – examination record

Objective examination:

- Deeply stuporous, GCS 9 (E2V3M4), spontaneous and regular breathing (BF 18/min, SpO2 95% without O2 supp.), 80 BPM, responds to an algic stimuli with an unorganised defensive reaction/withdrawal, eyelid sym., Bulbs in the middle position, pupils isocoric (4/4), not following, oculocephalic reflex intact, while bulbs moving in all directions, the corneal reflex is present,…

Objective exam.:

- Stupor, GCS 9 (E2V3M4), breat.spont.,reg. (BF 18, SpO2 95%), HR 80BPM, eyelid sym., bulbs midd., isocoric (4/4), not follow., oculoceph.r. +/+ with oculomot. intakt., corneal.r +, …

Consciousness – examination record

3) What is **the cause** of the disability?

- The diagnosis depends on the **anamnesis, objective examination and paraclinical examination** (e.g., brain imaging or blood sampling).
- We should realize whether these are more:
  - **Diffuse - encephalopathy** (e.g., metabolic, post-anoxic involvement, hypoglycemic coma, uremic coma, etc.) and is therefore a generalized involvement of the brain (stem and hemispheres), including the ARAS system.
  - **Supratentorial lesion** (localized, focal symptoms) - a lesion above the tentorium cerebelli (mesencephalon), which is usually accompanied by an increase in intracranial pressure (e.g., swelling) and a possible impairment of consciousness is caused by oppression of the brain stem (e.g., transtentorial herniation).
  - **Infratentorial lesions** (localized, focal symptoms) - lesions of the brain stem (e.g., a stroke in the posterior cerebral circulation, expansion process in the cerebellar corner, etc.)

Disorders of consciousness - syndromes

APALLIC SYNDROME (Coma vigile, vegetative state)
= impaired consciousness with **preserved vigilance/vigility, but without signs of lucidity** (the patient opens his/her eyes spontaneously or after stimulation, but does not realize him/herself, does not perceive the surroundings, does not respond correctly)

- Usually with extensive cortico-subcortical brain damage (often after hypoxia after CPR, extensive brain trauma), while the **structures of the diencephalon and brainstem are preserved.**
- Patient breathes spontaneously, often wandering movements of bulbs that do not fix can be seen, the brainstem reflexes are intact, lacking higher cortical functions, however KP comp., There may be increased perspiration or other disorders of the autonomous system.
- Sometimes there may be vocalization or spontaneous limb movements.

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Spinal examination

Jan Kočica, Blanka Adamová

SPINAL EXAMINATION

– We examine the cervical, thoracic and lumbar region.

ASPECTION

SPINE POSITION AND POSTURE

The examiner assesses **statics** (ie spine posture - curvature (scoliosis (coronary), lordosis, kyphosis)) and **dynamics** (ie spine development - forward and tilt (anteflexion and retroflexion), inclination (side bends) and rotation). We mainly monitor the atypical position of the spine.

PALPATION AND PERCUSSION

The examiner palpates mainly paravertebral muscle spasms.

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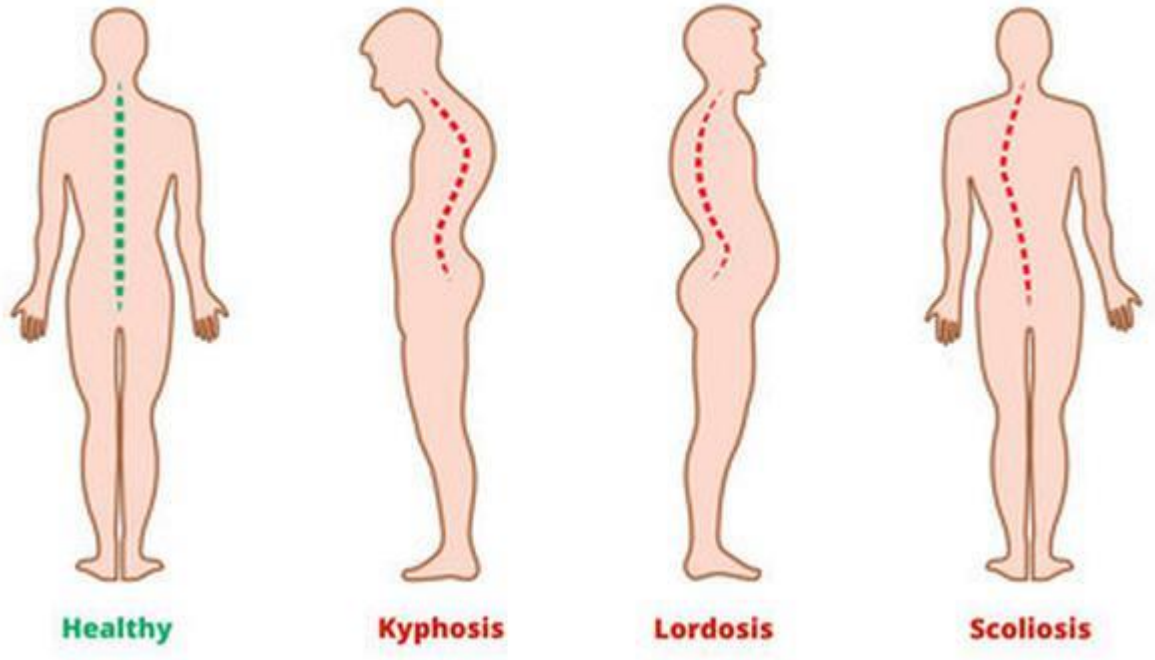
SPINAL EXAMINATION

ASPECTION
SPINE POSITION AND POSTURE
STATICS DISORDERS
HYPEKYPHOSE (sag.)
HYPERLORDOSIS (sag.)
SCOLIOSIS (cor.)

In addition to birth defects (including eg abbreviations the lower limb/s), scoliosis must also be monitored in patients with hemiparesis (eg demyelinating diseases or ischemic diseases).



SPINAL EXAMINATION

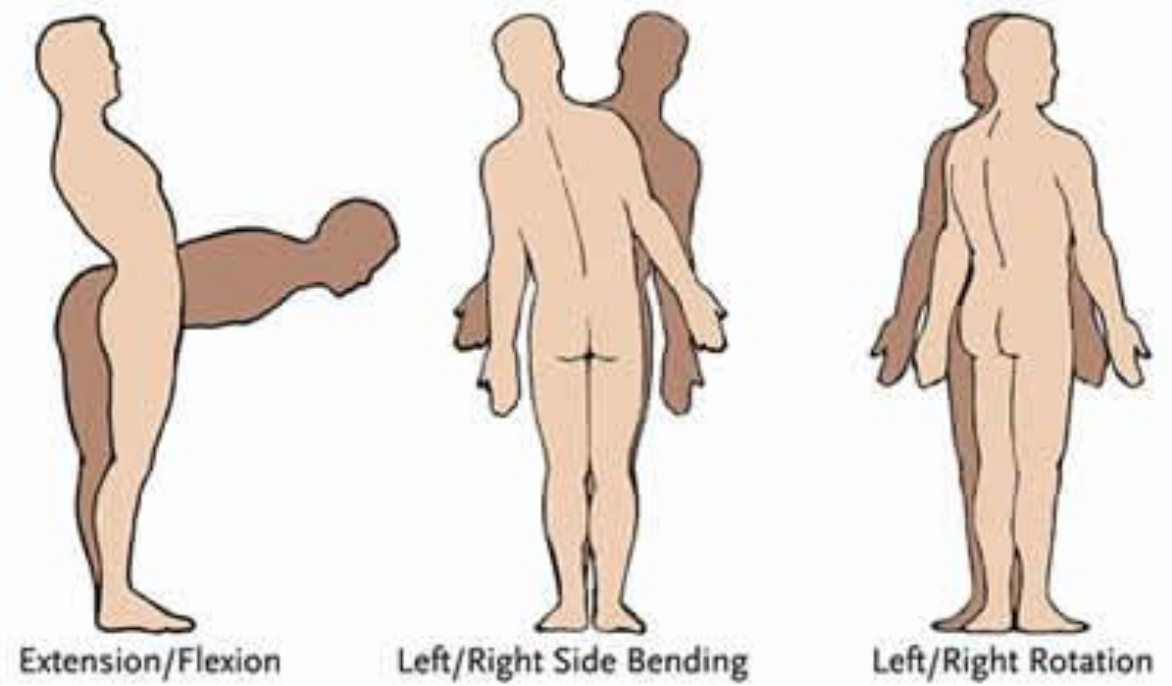
ASPECTION

SPINE POSITION AND POSTURE

DYNAMICS DISORDERS

First, we observe the **standing position** (antalgic posture? Defective rotation?)

We examine both with **active patient movement** (upon request) and **then passively** (with the help of the examiner)



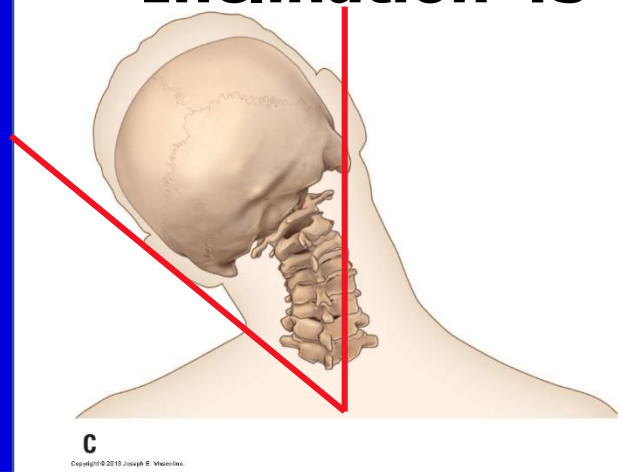
ℹ CAVE: when traumatic changes are suspected!

SPINAL EXAMINATION

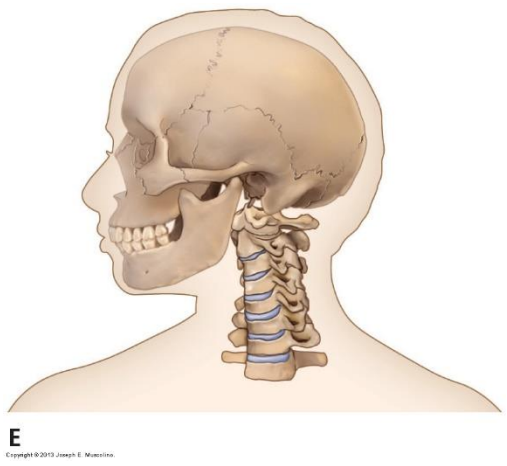
CERVICAL SPINE EXAMINATION

- Best while **sitting**.
- Is the head at rest normal? (rotation to one side with lifting of the arm?)
- Blockages of the cervical spine **in the upper section** are more pronounced when the **head rotates in the forward bend**.
- Blockages of the cervical spine in **the lower section** are more pronounced when the **head rotates in the backward bend.**
- Paravertebral spasms? Percussion pain?

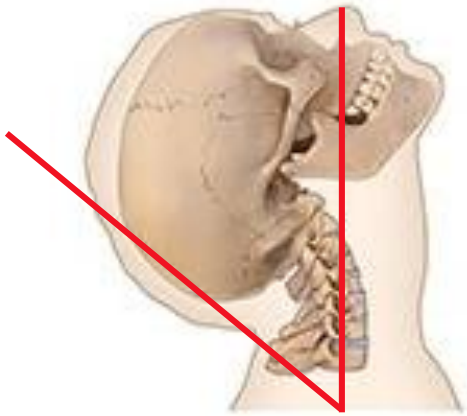
Inclination 45°



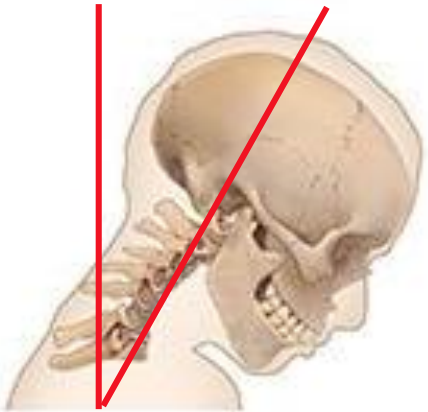
Rotation 80°



Extension 80°



Flection 50°



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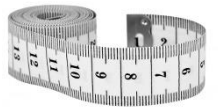
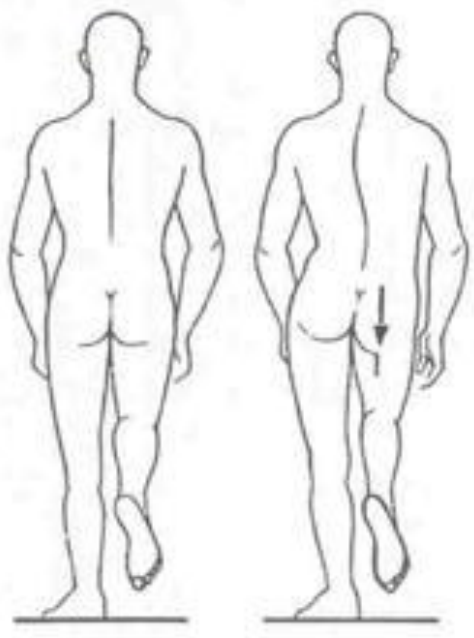
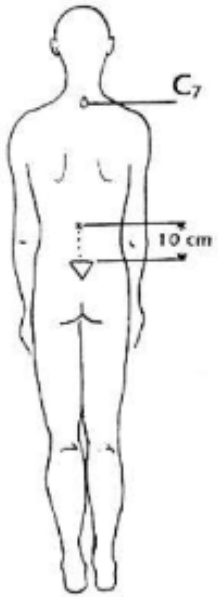
SPINAL EXAMINATION

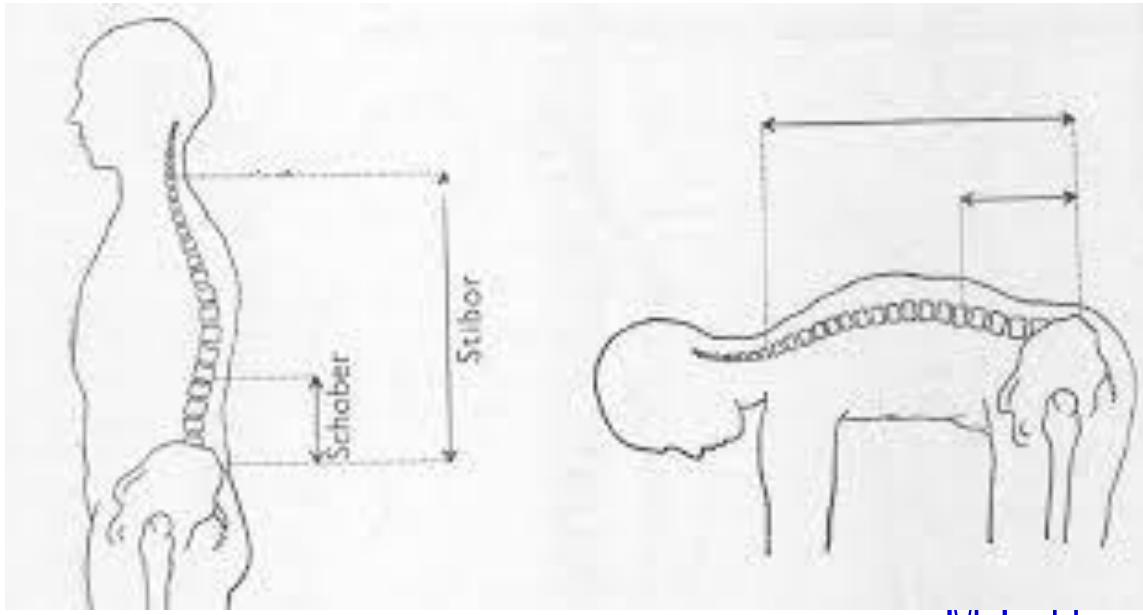


THORACIC SPINE EXAMINATION

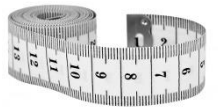
- We also investigate **sitting down** a patient.
- **Quantification tests** („GREAT“ SCHOBER, STIBOR)
- **SCHOBER TEST FOR CHEST MOBILITY** (so-called "GREAT SCHOBER")
  - We mark C7 + 30 cm caudally (use, for example, a tailor's tape), their distance will **increase to 33-34 cm when bending forward** and will decrease to **28-29 cm when bending backward**.







SPINAL EXAMINATION

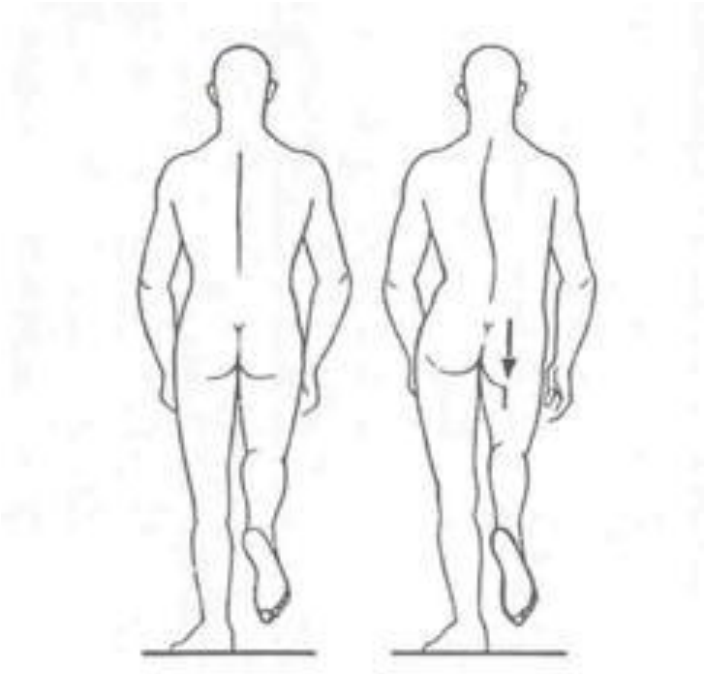


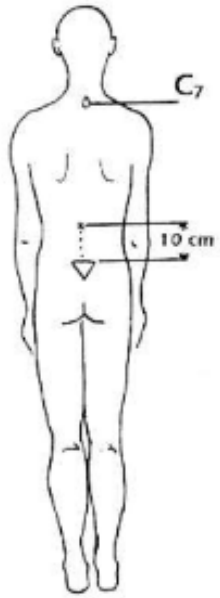
THORACIC SPINE EXAMINATION

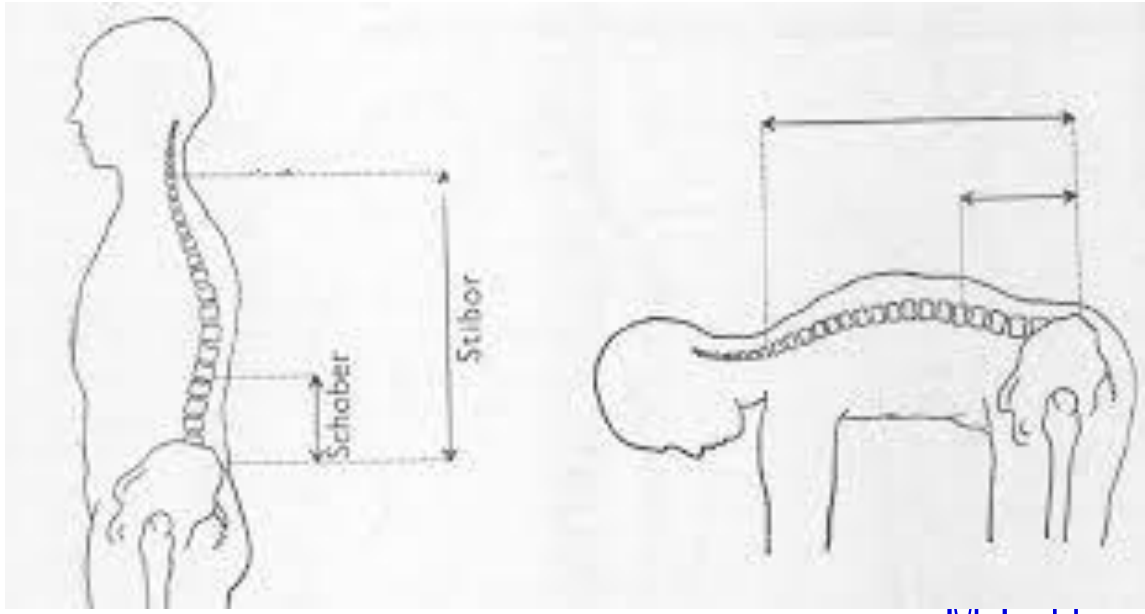
- We also investigate **sitting down** a patient.
- **Quantification tests** („GREAT“ SCHOBER, STIBOR)

STIBOR TEST

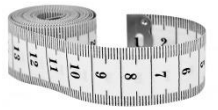
- Mark C7 and L5 and measure the distance. When bending forward, it **increases by 10 cm and more**.







SPINAL EXAMINATION

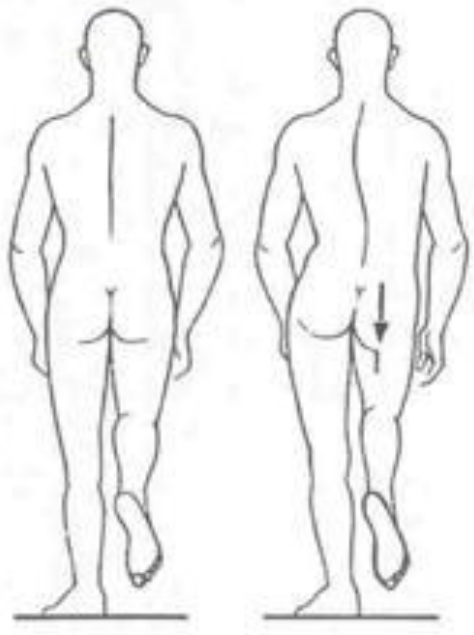


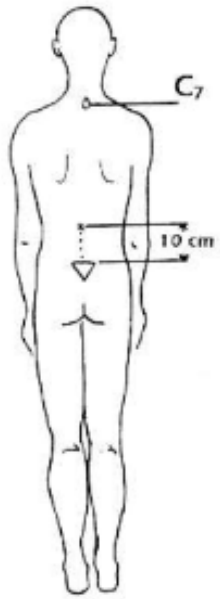
LUMBAR SPINE EXAMINATION

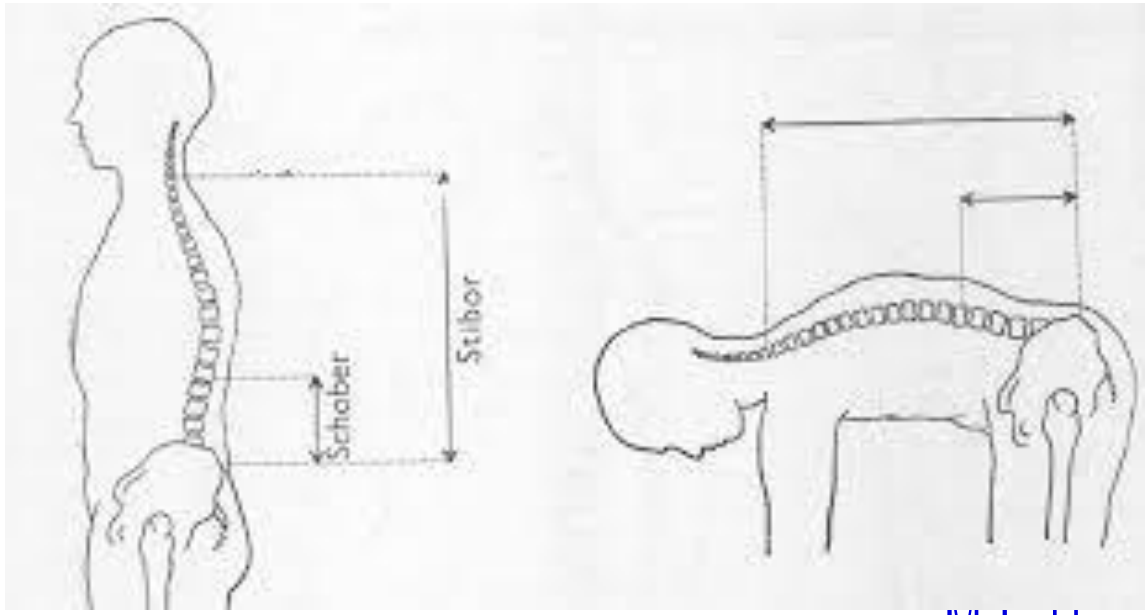
- Examined best while **standing**.
- Among other things, the **length of the lower limb/s** and the position of the pelvis are evaluated.

SCHOBER TEST FOR LUMBAR SPINE MOBILITY (so-called "SMALL SCHOBER")

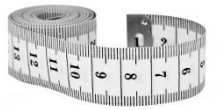
- Make a mark above the S1 and another 10 cm cranially, while in maximum forward bend, the marks should move away by 5 cm, shortening by 1-2 cm at the backward bend.







SPINAL EXAMINATION

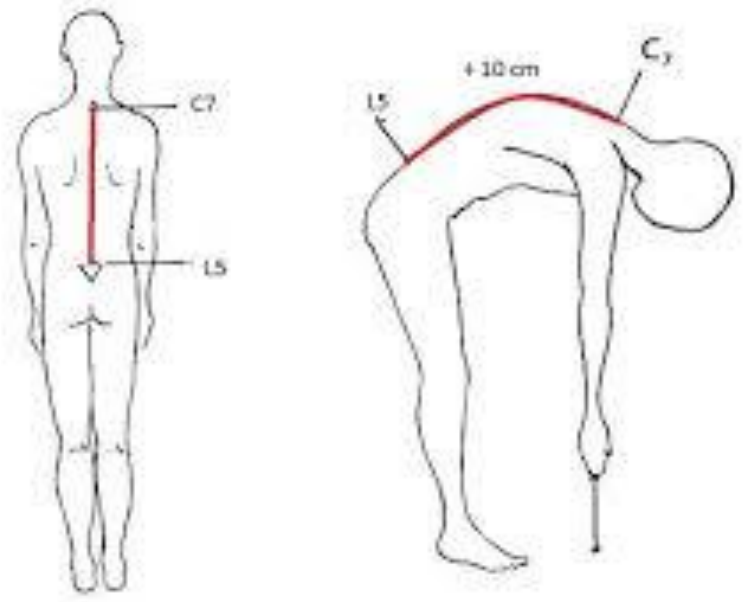


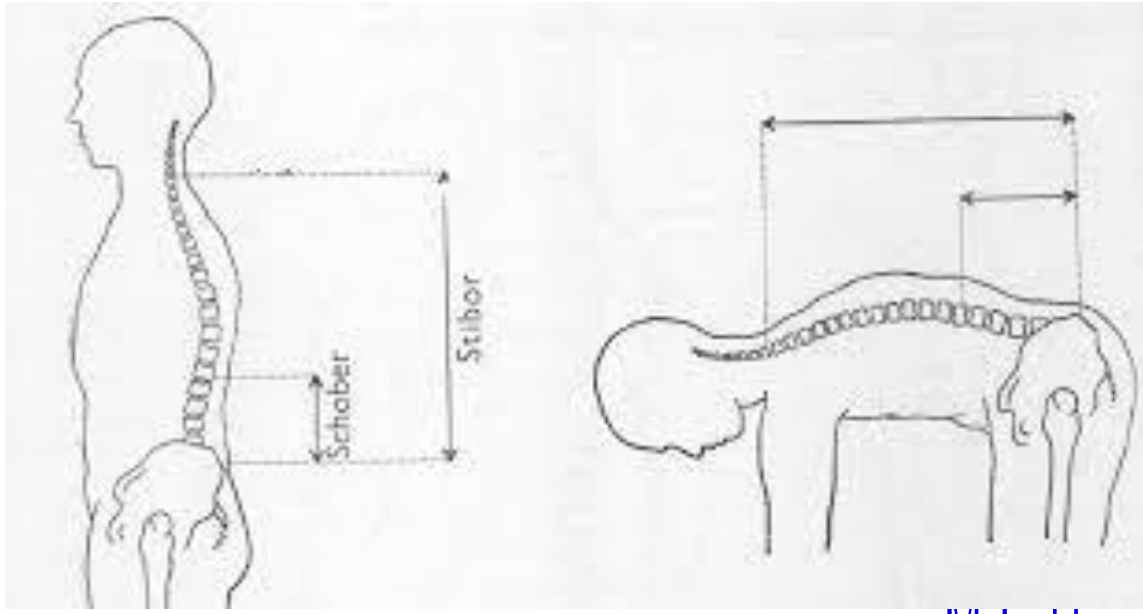
LUMBAR SPINE EXAMINATION

- Examined best while **standing**.
- Among other things, the **length of the lower limb/s** and the position of the pelvis are evaluated.

THOMAYER TEST

- In the **maximum active forward bend**, we measure the **distance of the patient's fingertips from the floor**. We also monitor the development of the spine during this test.





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