Talks and seminars on NS at the (internal) web server of Medical Faculty 1: dec52.lf1.cuni.cz

This seminar „Examination in Neurology“:

https://dec52.lf1.cuni.cz/~pmar/ftp/PPT-PATF/PPT-sem-EN/

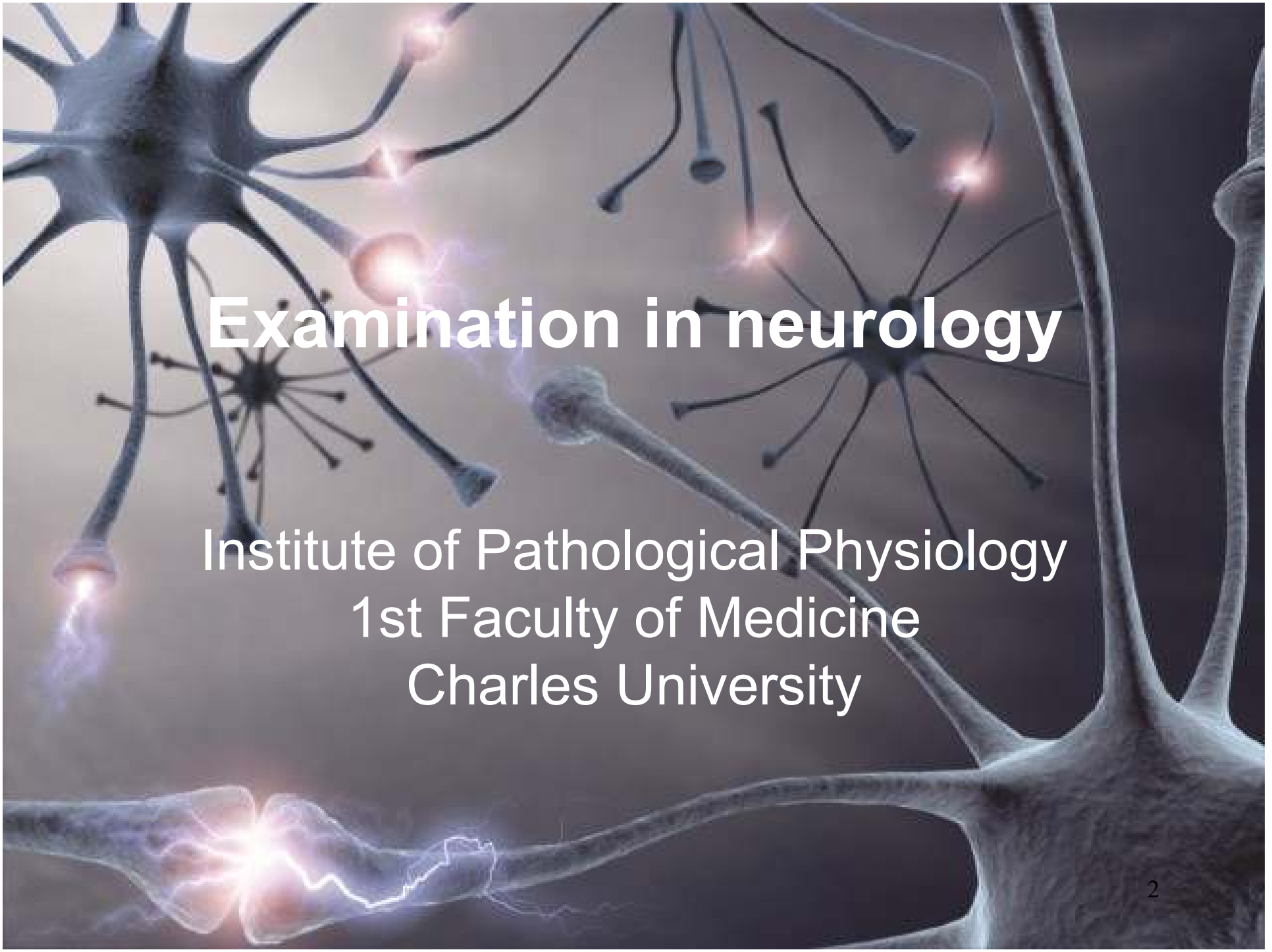
pptx and pdf files

All Talks on NS:

https://dec52.lf1.cuni.cz/~pmar/ftp/PPT-PATF/...

Seminar on Diagnostic Methods:

SE-Nerv-Syst-Diag-EN-2025-etc.pptx



Examination in neurology

Institute of Pathological Physiology
1st Faculty of Medicine
Charles University

Examination methods

- patient history (anamnesis)
- status praesens
- objective examination
- laboratory examination
- (therapeutic plan)

What do we need?

- neurological hammer
- flash light
- tuning fork
- sharp pin
- cotton buds
- measuring meter

neurological- psychological (vs. psychiatric) examinations (from Thieme Color Atlas of Neurology)

Aspect To Be Tested	Questions/Tests
• Attention (p. 116)	• Awake, somnolent, stuporous, comatose? Arousability, attention span, perception
• Orientation	• Personal data (name, age, date/place of birth), orientation ("where are we?", place of residence); time (day of the week, date, month, year); situation (reason for consultation, nature of symptoms)
• Memory, recall	• The patient should be able to name the months of the year backward, spell a word backward, repeat random series of numbers between 1 and 9. Can the patient recall 3 objects mentioned 3 minutes ago, recall figures, name famous people? Tests of general knowledge
• Serial subtraction	• Serial subtraction of 3s (or 7s), starting from 100
• Frontal lobe function	• Perseveration[1]; hand sequence test[2]; proverb interpretation
• Language (pp. 124, 128)	• Following commands, naming, repetition, writing, reading aloud, simple arithmetic
• Praxis	• See p. 128
• Spatial orientation, visual perception	• See p. 132. Naming of colors and objects

Anamnesis

- family history of neurological diseases
- all pathological changes, which cause the patients their problems
- other personal medical history
- work and social anamnesis (patient's ability)

Present status

- I. Mental, intellectual status (specific in children, standard in adult patients)
- II. Cranial nerves
- III. Motor function
  - upper and lower extremity
  - extrapyramidal, cerebellar signs
- IV. Standing and gait
- V. Somatosensory function

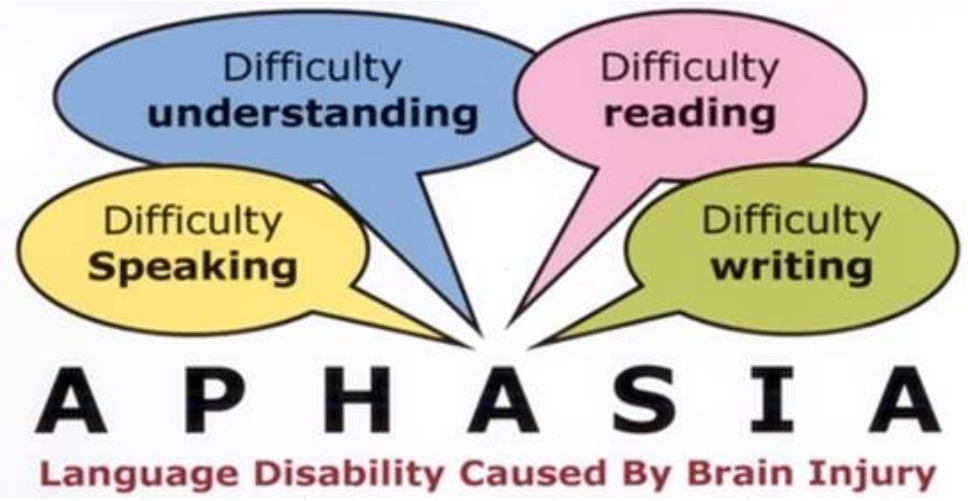
Mental status examination

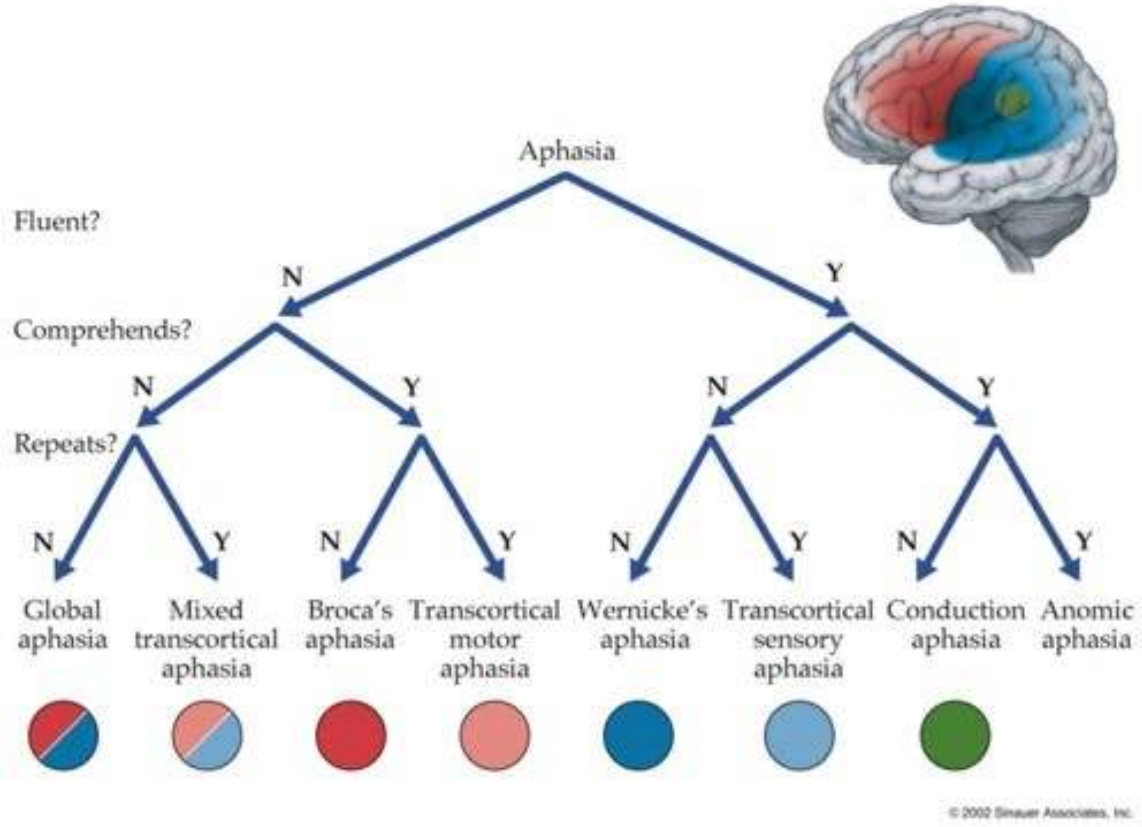
- Mini-Mental State Examination (MMSE)
  - Long term memory (name, birthday, place of living, name of the president, this place)
  - Short term memory (repetition of three short words)
  - Phatic functions
    - spontaneous speech, repetition of grammatical particles (no ifs, buts or ands)
    - calculation (subtracting 7 from 100)
    - practical skills (knot the tie, dressing, gestures)

Mental status examination

- writing a sentence
- (copy of a simple picture)
- detailed neuropsychological and/ or psychiatric examination

Aphasia


Difficulty understanding
Difficulty reading
Difficulty Speaking
Difficulty writing
APHASIA
Language Disability Caused By Brain Injury


Aphasia
Fluent?
Comprehends?
Repeats?
N
Y
Global aphasia
Mixed transcortical aphasia
Broca's aphasia
Transcortical motor aphasia
Wernicke's aphasia
Transcortical sensory aphasia
Conduction aphasia
Anomic aphasia
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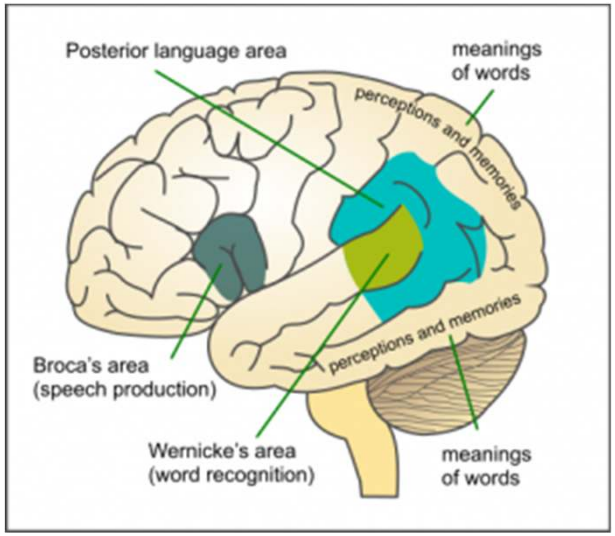
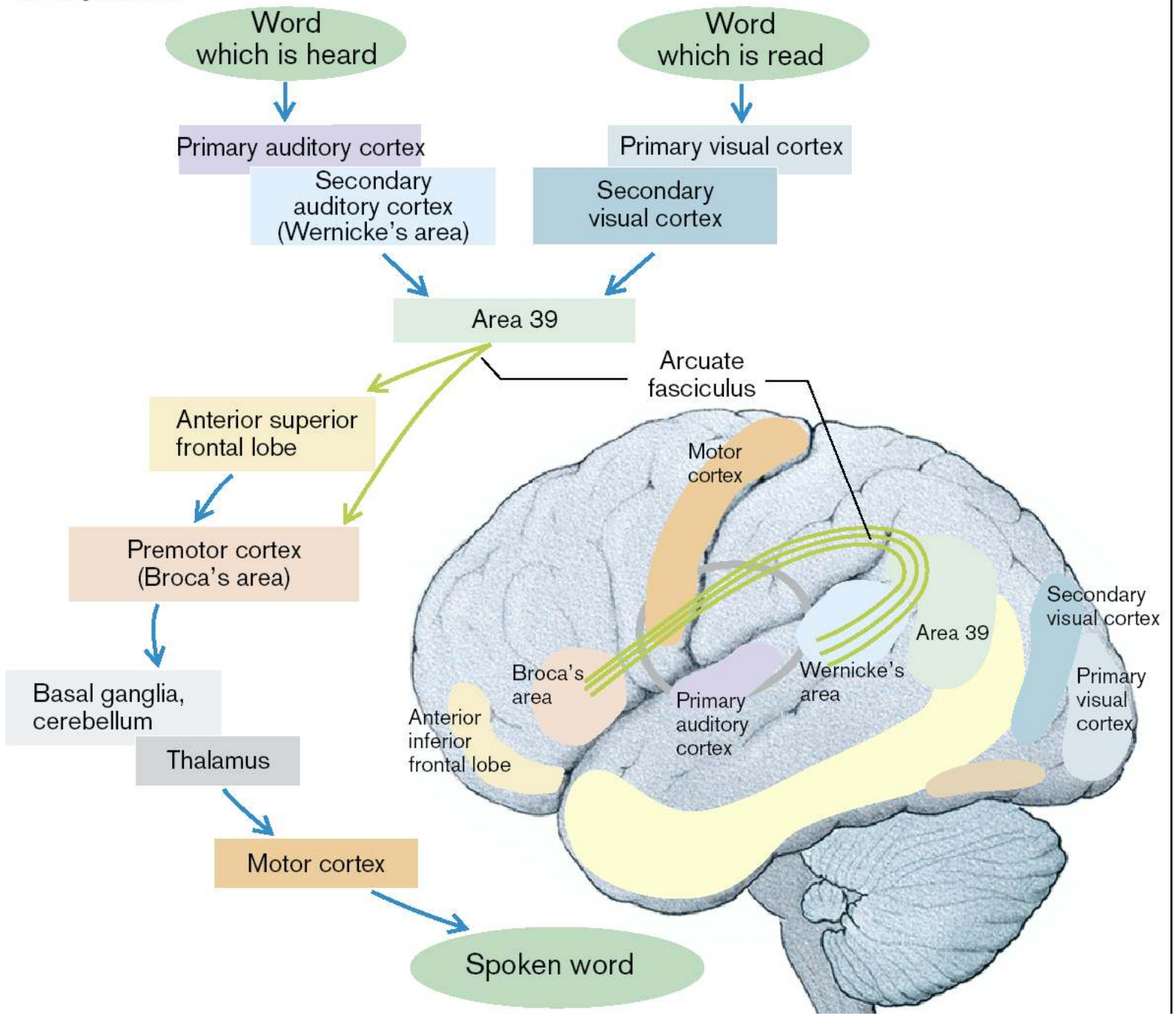

Posterior language area
meanings of words
perceptions and memories
Broca's area (speech production)
perceptions and memories
Wernicke's area (word recognition)
meanings of words

- A. Aphasias


Word which is heard
Word which is read
Primary auditory cortex
Primary visual cortex
Secondary auditory cortex (Wernicke's area)
Secondary visual cortex
Area 39
Arcuate fasciculus
Anterior superior frontal lobe
Premotor cortex (Broca's area)
Basal ganglia, cerebellum
Thalamus
Motor cortex
Spoken word
Motor cortex
Broca's area
Anterior inferior frontal lobe
Primary auditory cortex
Wernicke's area
Area 39
Secondary visual cortex
Primary visual cortex

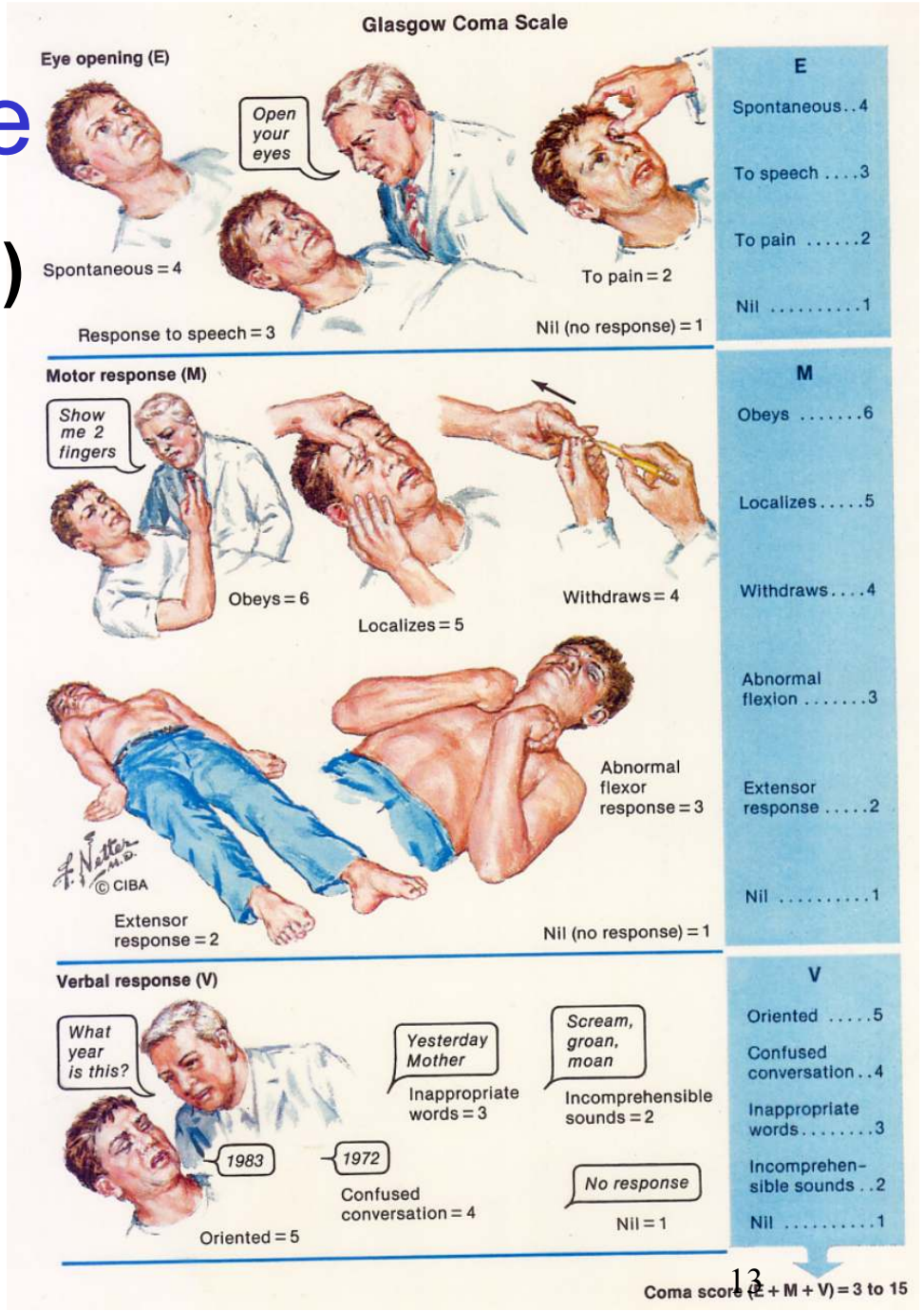
Type	Spontaneous speech	Repetition of words	Language comprehension	Finding words
Broca's aphasia	abnormal	abnormal	normal	impaired
Wernicke's aphasia	fluent (at times logorrhea, paraphasia, neologisms)	abnormal	impaired	impaired
Conduction aphasia	fluent, but paraphasic	markedly impaired	normal	abnormal, paraphasic
Global aphasia	abnormal	abnormal	abnormal	abnormal
Anomic aphasia	fluent	normal, but anomic	normal	impaired
Achromatic aphasia	fluent	normal, but anomic	normal	impaired
Motor transcortical aphasia	abnormal	normal	normal	abnormal
Sensory transcortical aphasia	fluent	fluent	abnormal	abnormal
Subcortical aphasia	fluent	normal	abnormal (transient)	abnormal (transient)

Glasgow coma scale

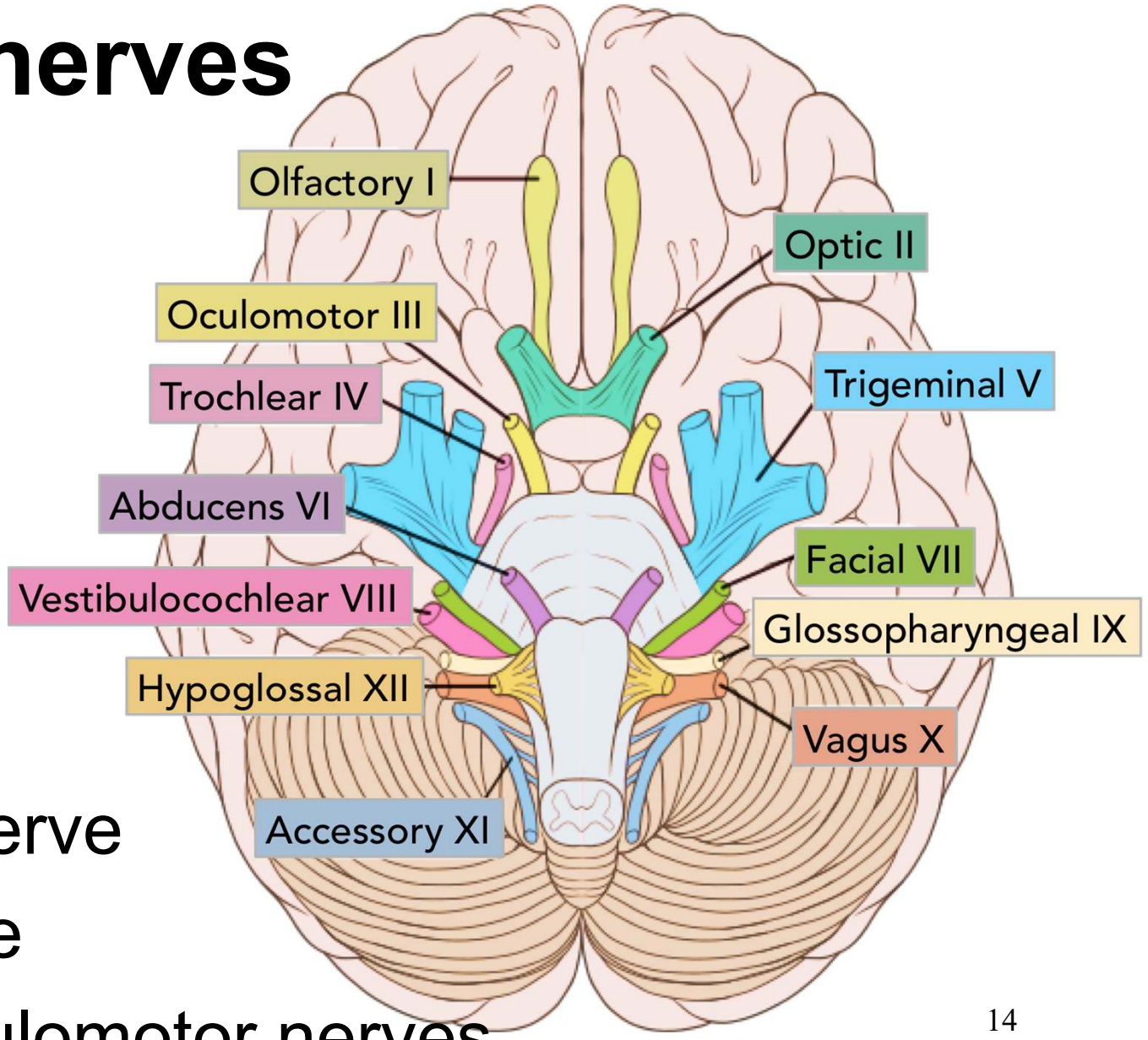
Glasgow coma scale (GCS)

- differences for adults and for small children
- lowest possible score: 3
- highest: 15 (fully conscious)

Sign	Pediatric GCS	Score
Eye opening	Spontaneous	4
	To sound	3
	To pain	2
	None	1
Verbal response	Smile, orientation to sound, interacts, follows objects	5
	Cries, irritable	4
	Cries to pain	3
	Moans to pain	2
	None	1
Motor response	Spontaneous movements (obeys command)	6
	Withdraws to touch (localizes pain)	5
	Withdraws to pain	4
	Abnormal flexion to pain (decorticate)	3
	Abnormal extension to pain (decerebrate)	2
	None	1

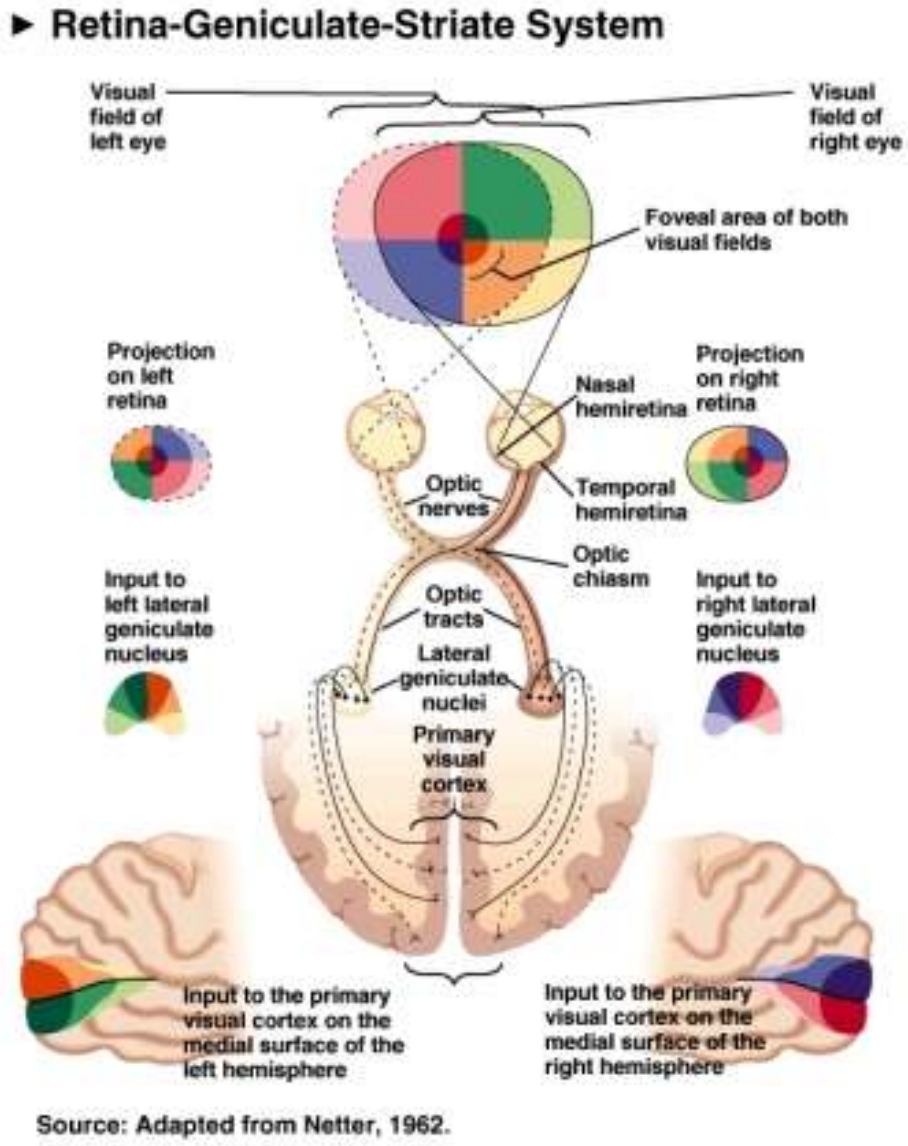


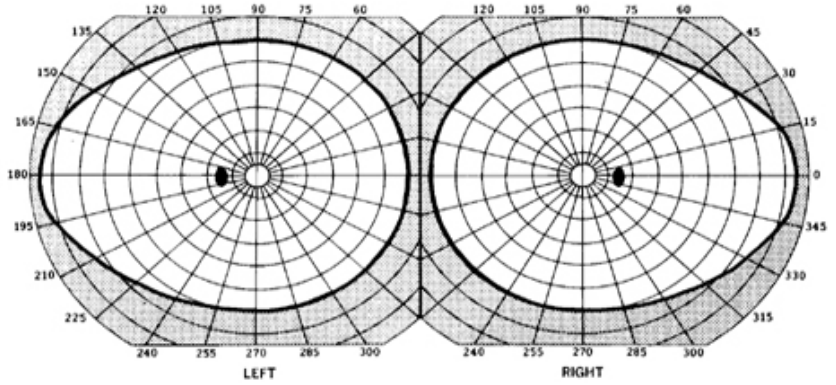
Examination of cranial nerves

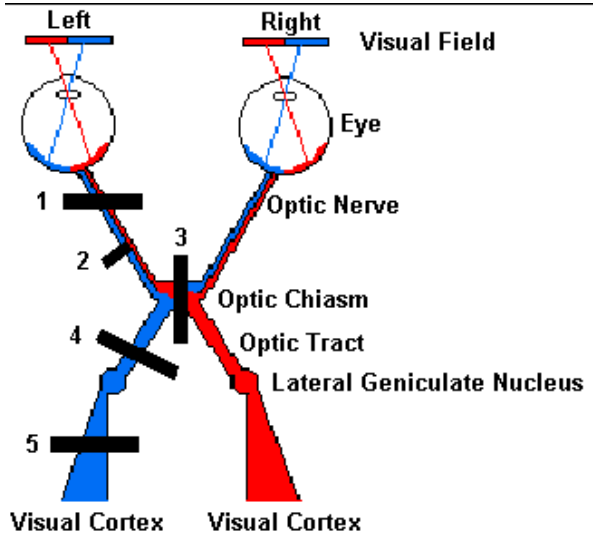


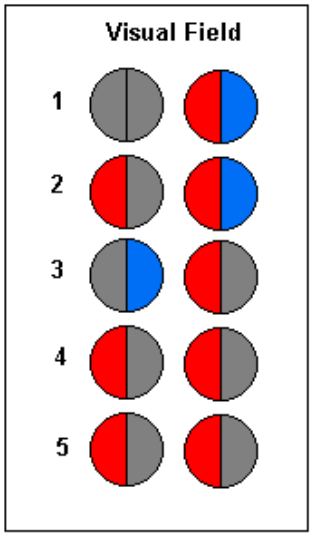
- I olfactory nerve
- II optic nerve
- III, IV, VI oculomotor nerves

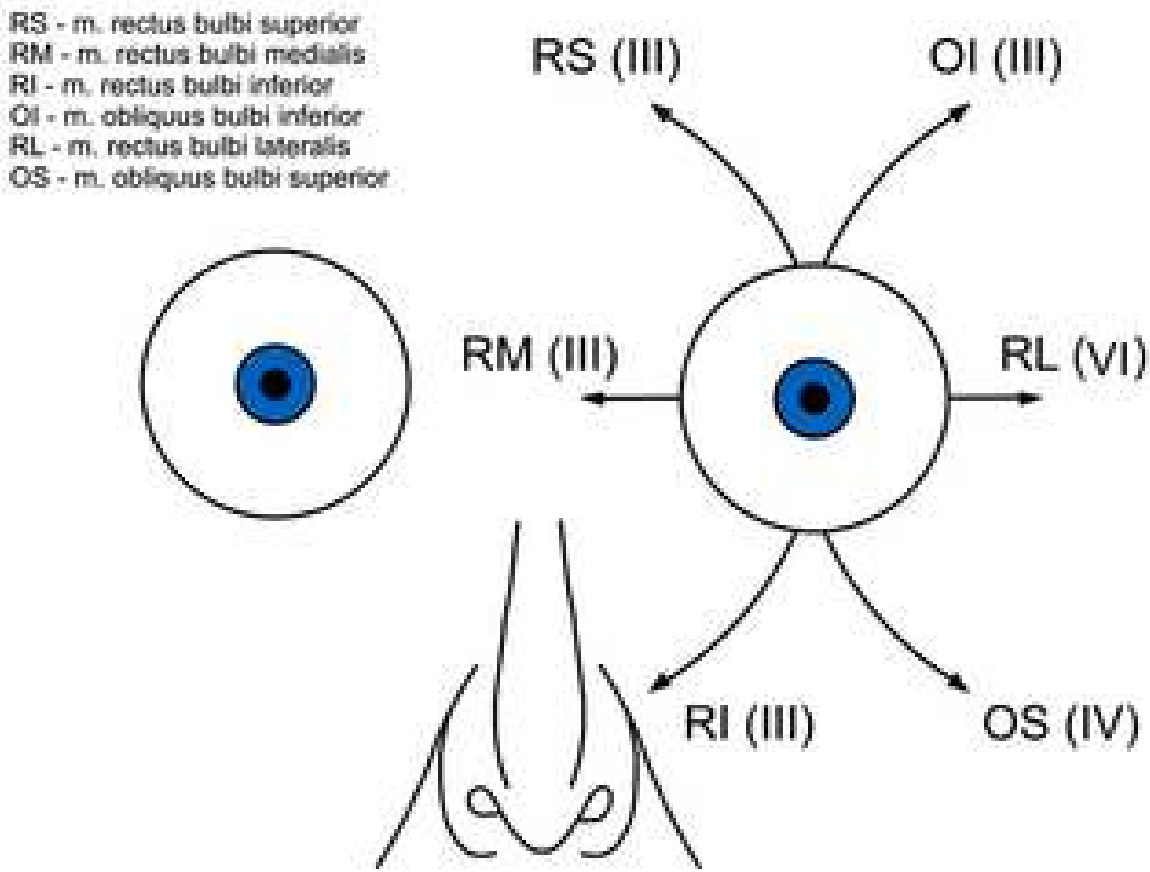
Visual field









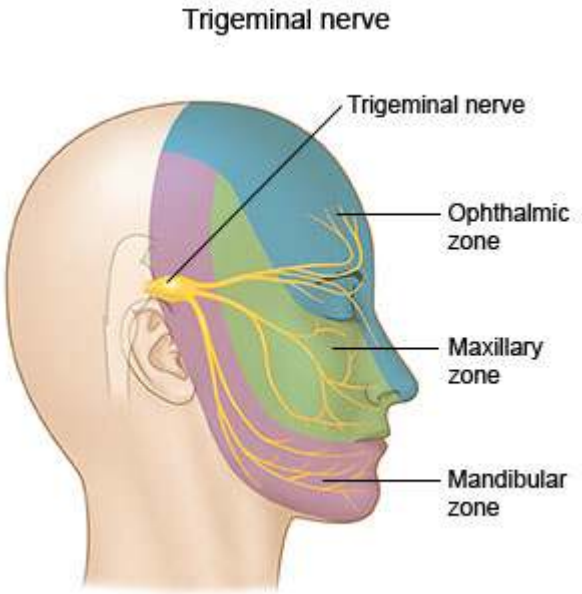


Examination of cranial nerves

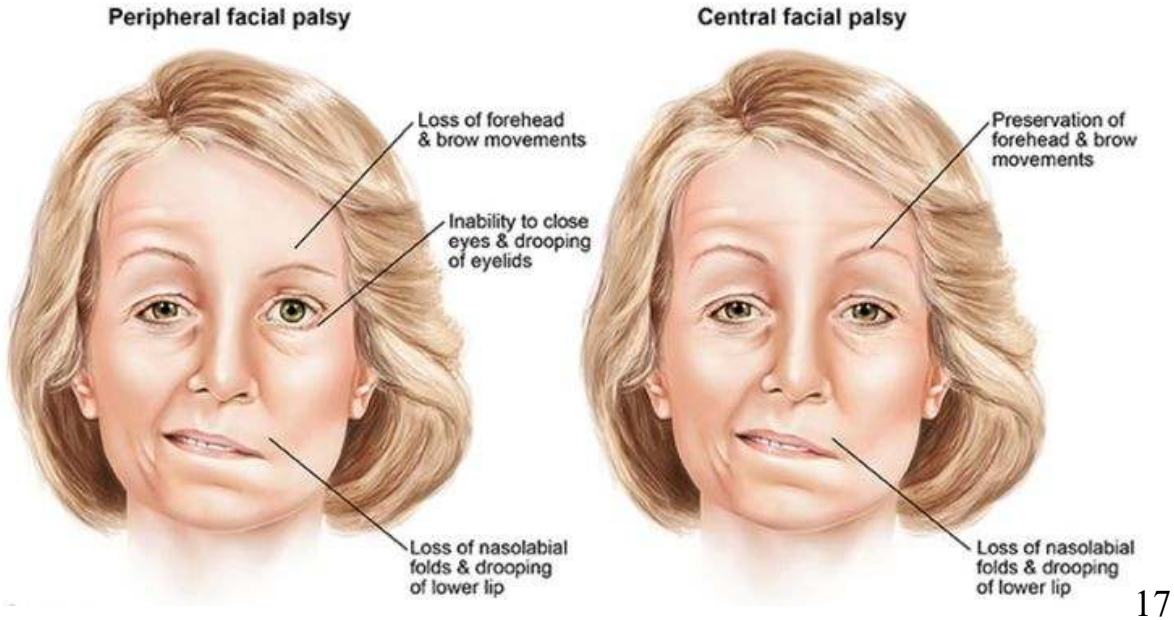
Oculo-motor nerves

Examination of cranial nerves

- V trigeminal nerve

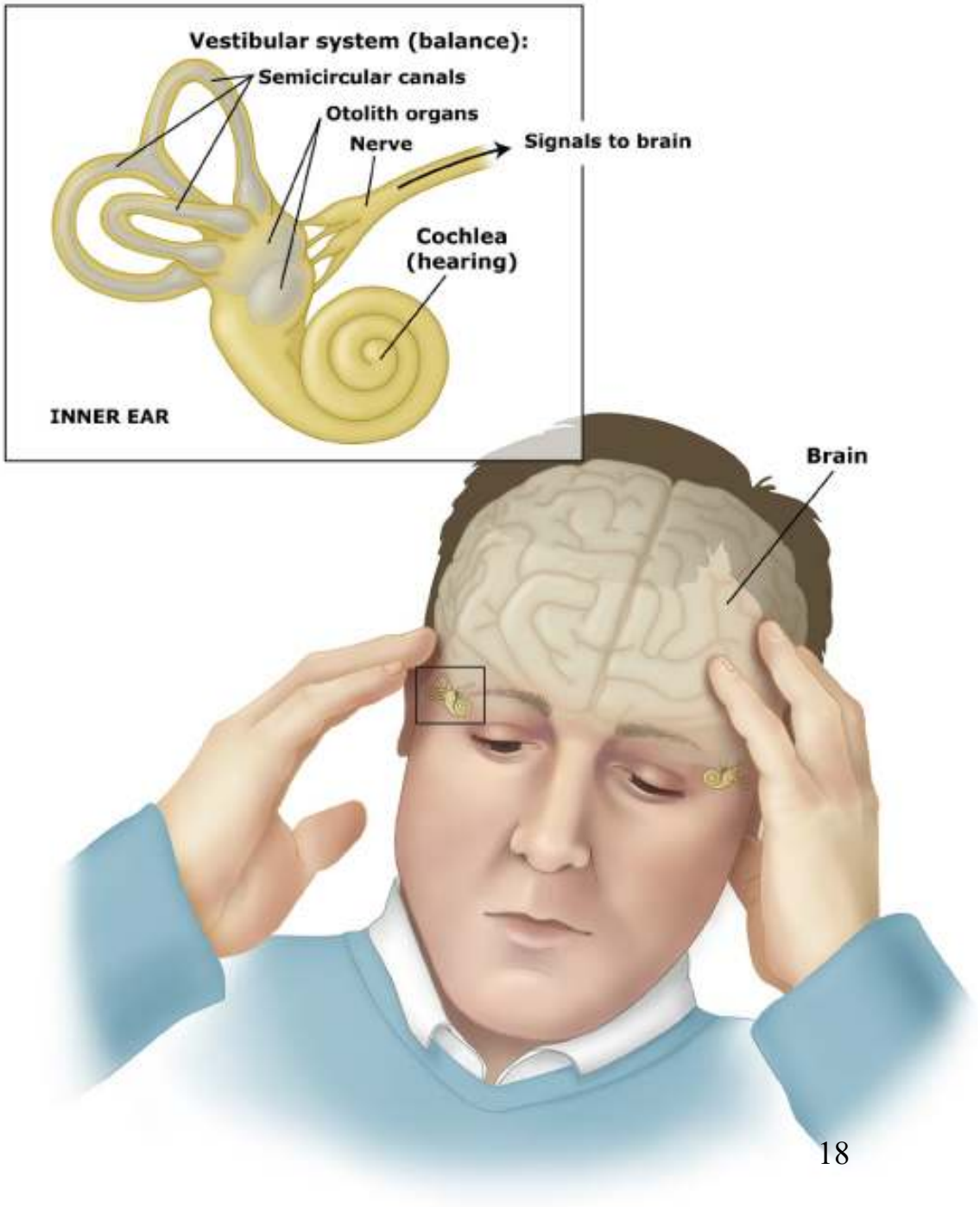


- VII facial nerve



Examination of cranial nerves

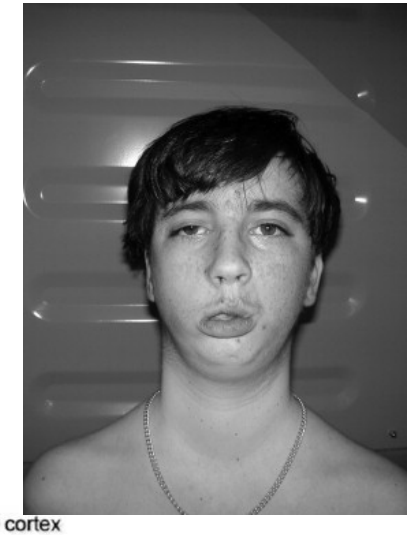
- VIII stato-acoustic nerve



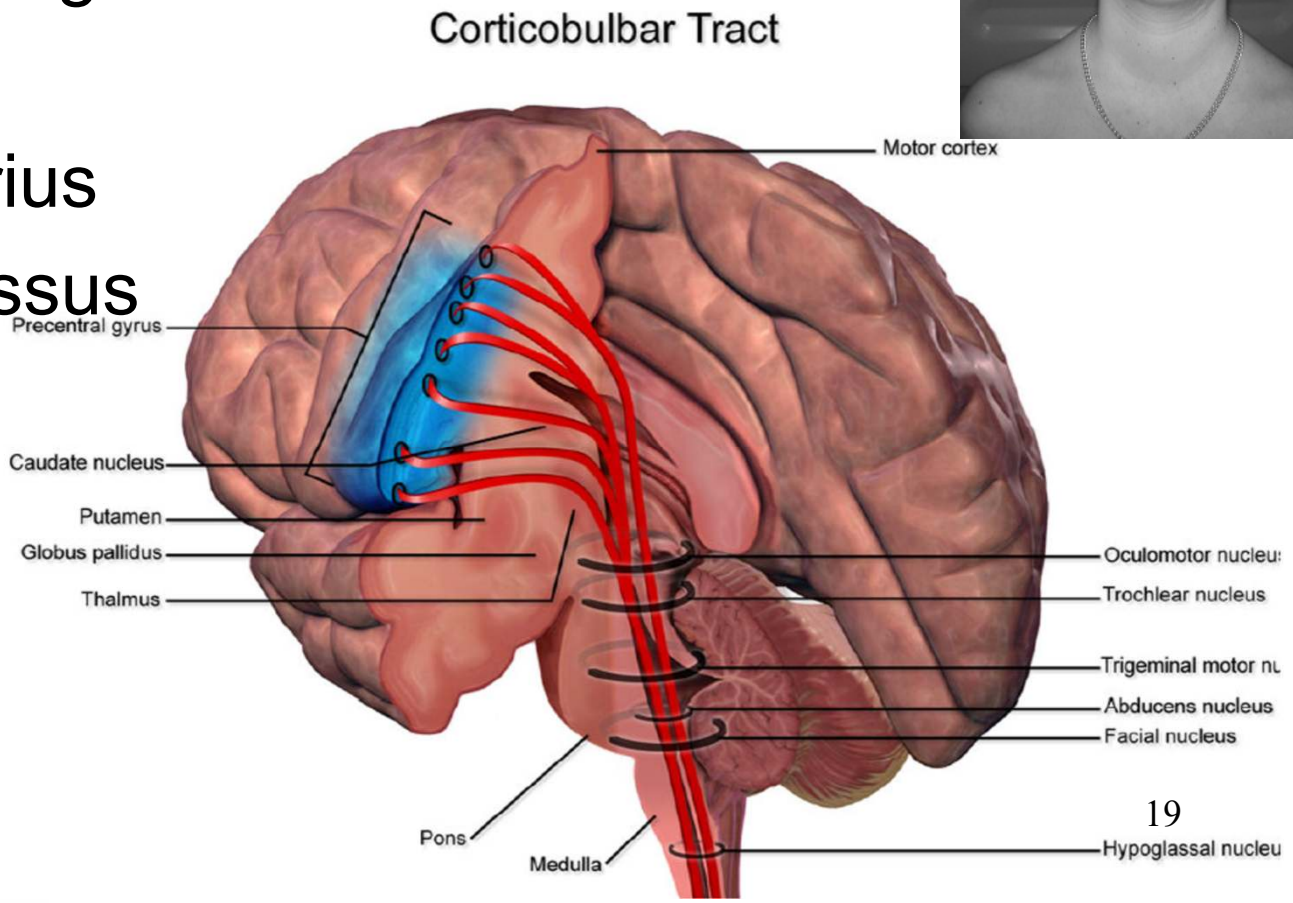
Examination of cranial nerves

location: cerebral‘bulbus’, bulbar paralysis/ bulbar palsy

- IX glossopharyngeus
- X vagus
- XI accessorius
- XII hypoglossus



" I test for gag reflex by talking about gas prices. "



Examination of cranial nerves/ bulbar paralysis/ palsy
(bulbus = medulla oblongata)

Symptoms

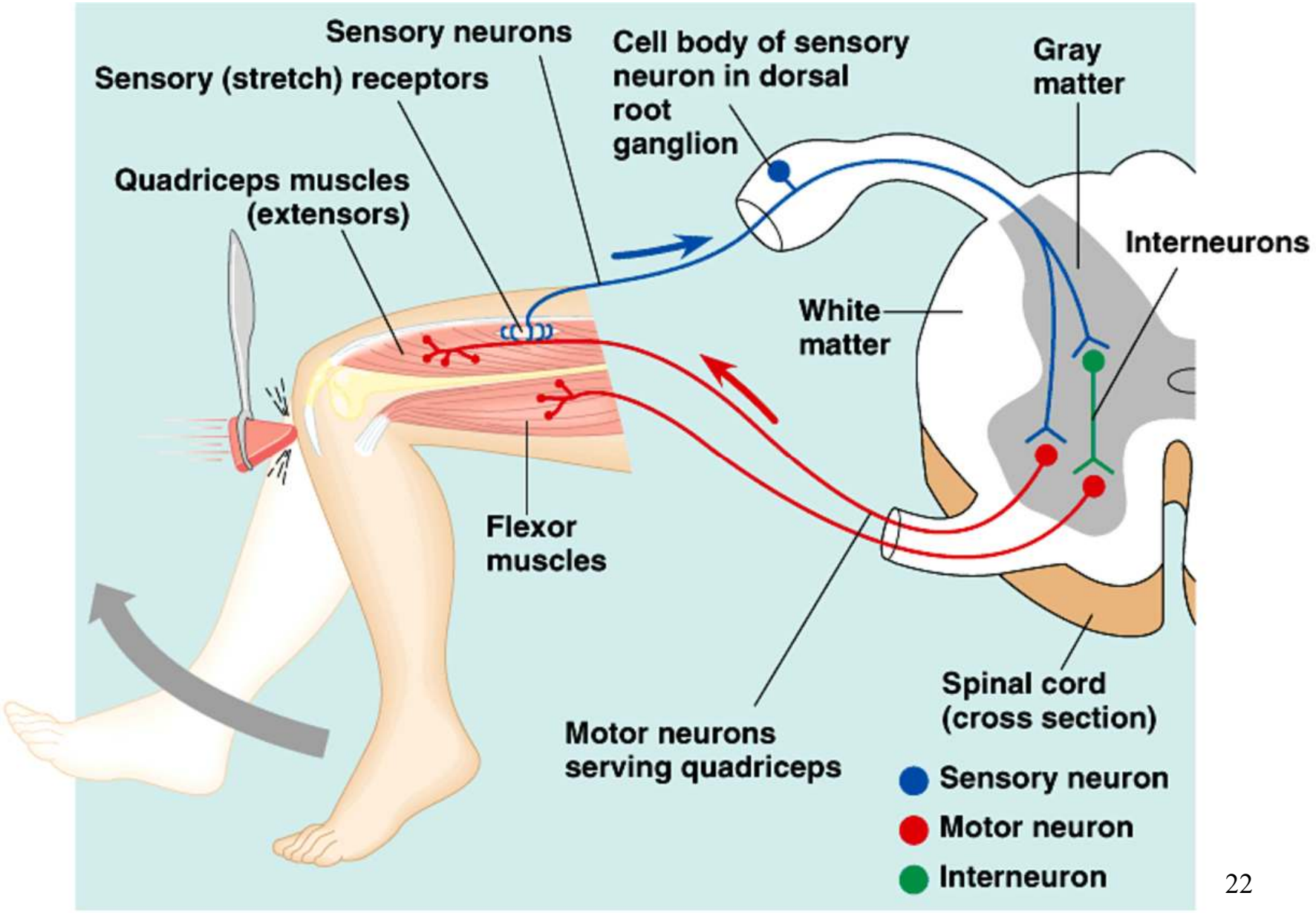
•**dysphagia** (difficulty in swallowing)
•difficulty in chewing
•nasal regurgitation
•slurring of speech
•difficulty in handling secretions
•choking on liquids
•dysphonia (defective use of the voice, inability to produce sound due to muscular /laryngeal/ weakness)
•**dysarthria** (difficulty in articulating words due to a CNS problem)

- IX glossopharyngeus
- X vagus
- XI accessorius
- XII hypoglossus

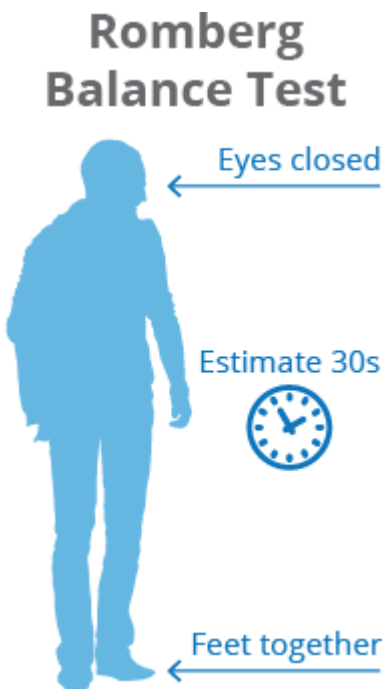
Extremities

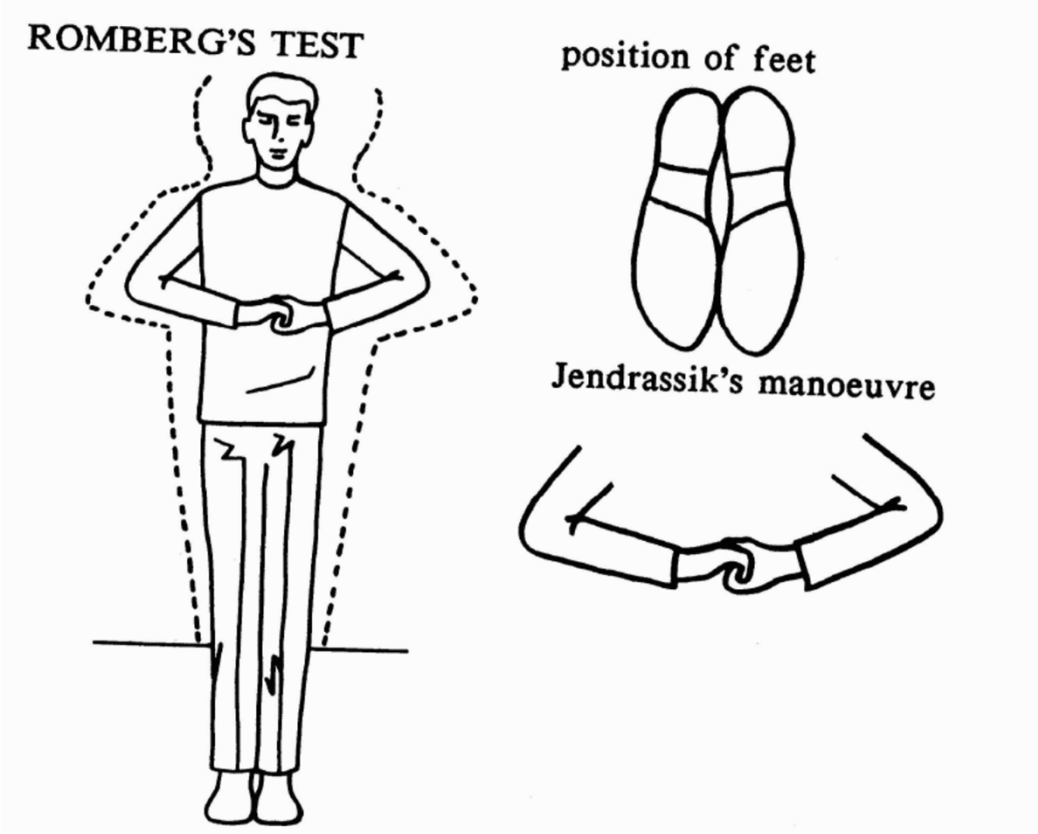
- Range of movements
  - active (paresis - neurology) X passive (skeletal, joint or ligaments - orthopaedics)
- strength, muscle tone
- paretic pyramidal signs (Mingazzini, Dufour)
- irritative pyramidal signs (Babinski, Juster)
- myotatic reflexes (spinal cord segment responses)
- cerebellar syndromes
  - taxis, diadochokinesis, muscle atonia, intention tremor
- extrapyramidal syndrome
  - elementary postural reflexes
  - rigidity, bradykinesia, static tremor

Spinal reflexes



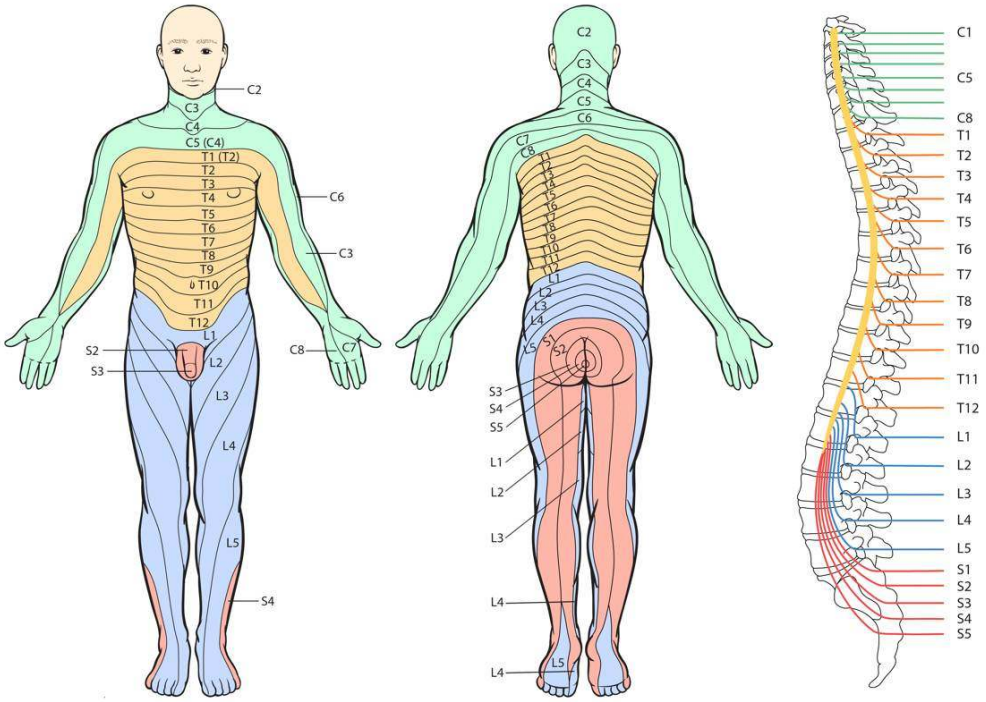
Standing and gait

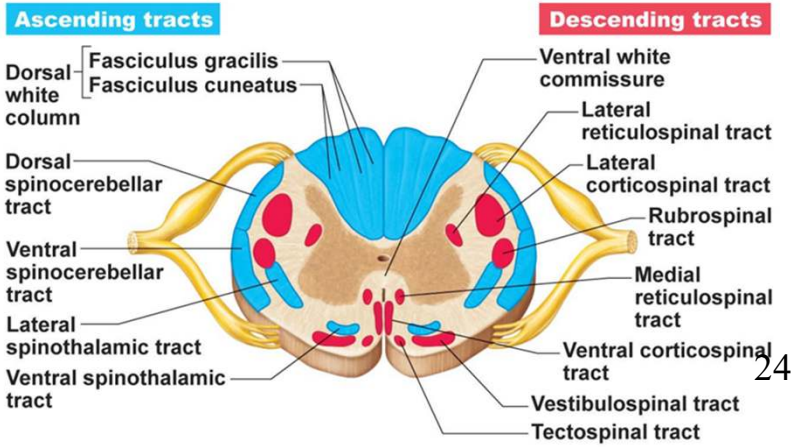




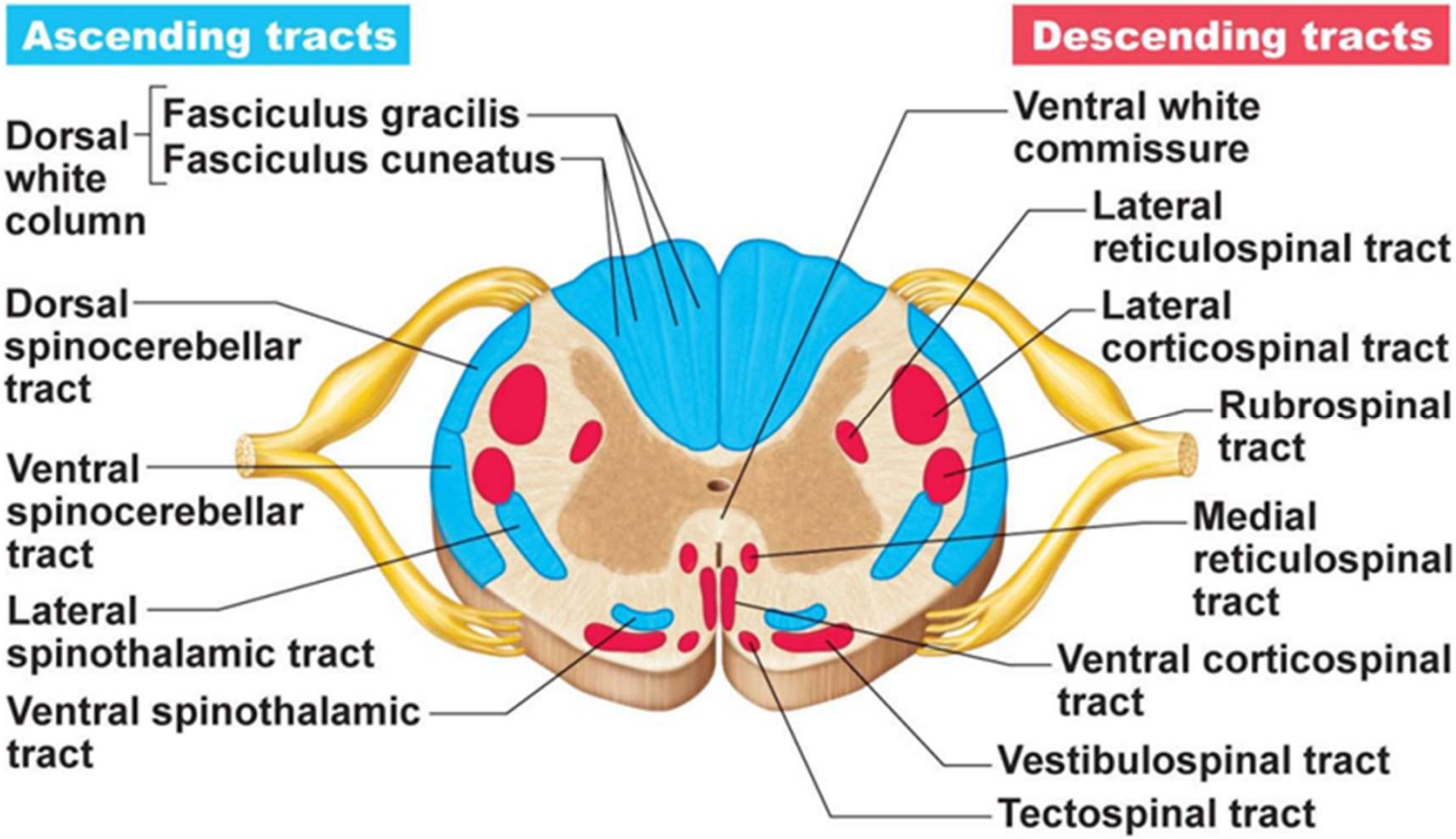
Somatosensory examination

- touch and pressure
- deep sensation, proprioception
  - lemniscal, dorsal column
- pain and thermic sensation
  - spinothalamic tract
- vibration sense by tuning fork
  - dorsal column

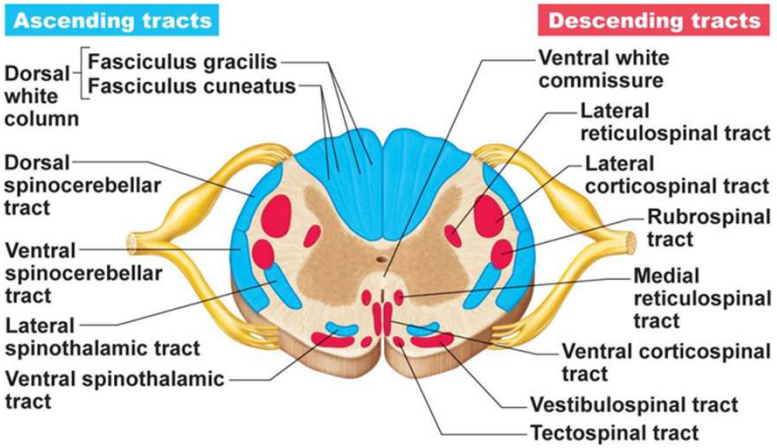


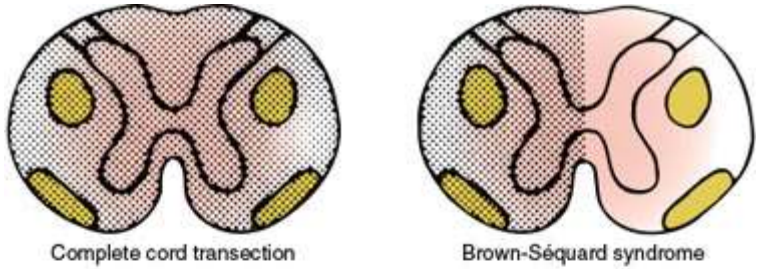


Spinal tracts

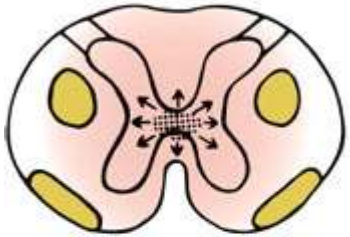


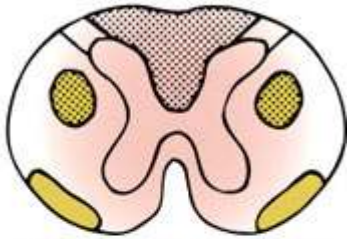
What should we know about spinal tracts?




Complete cord transection

Brown-Séquard syndrome

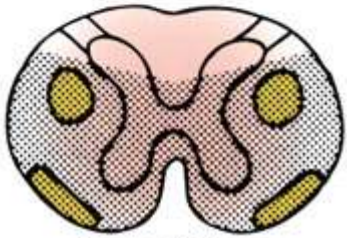

Central lesions (syringomyelia)


Posterolateral column syndrome (subacute combined degeneration)

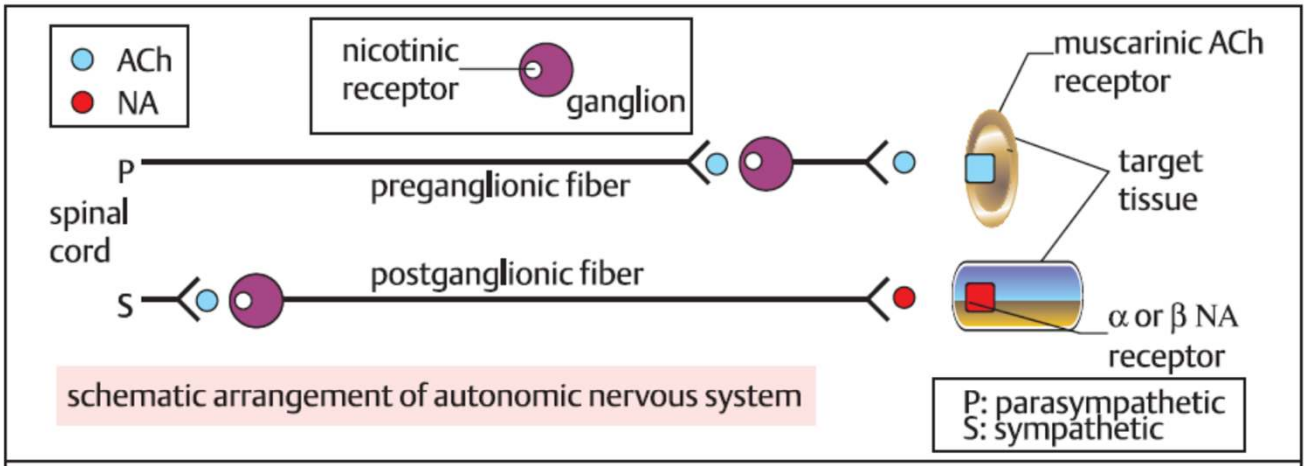

Posterior column syndrome (tabes dorsalis)

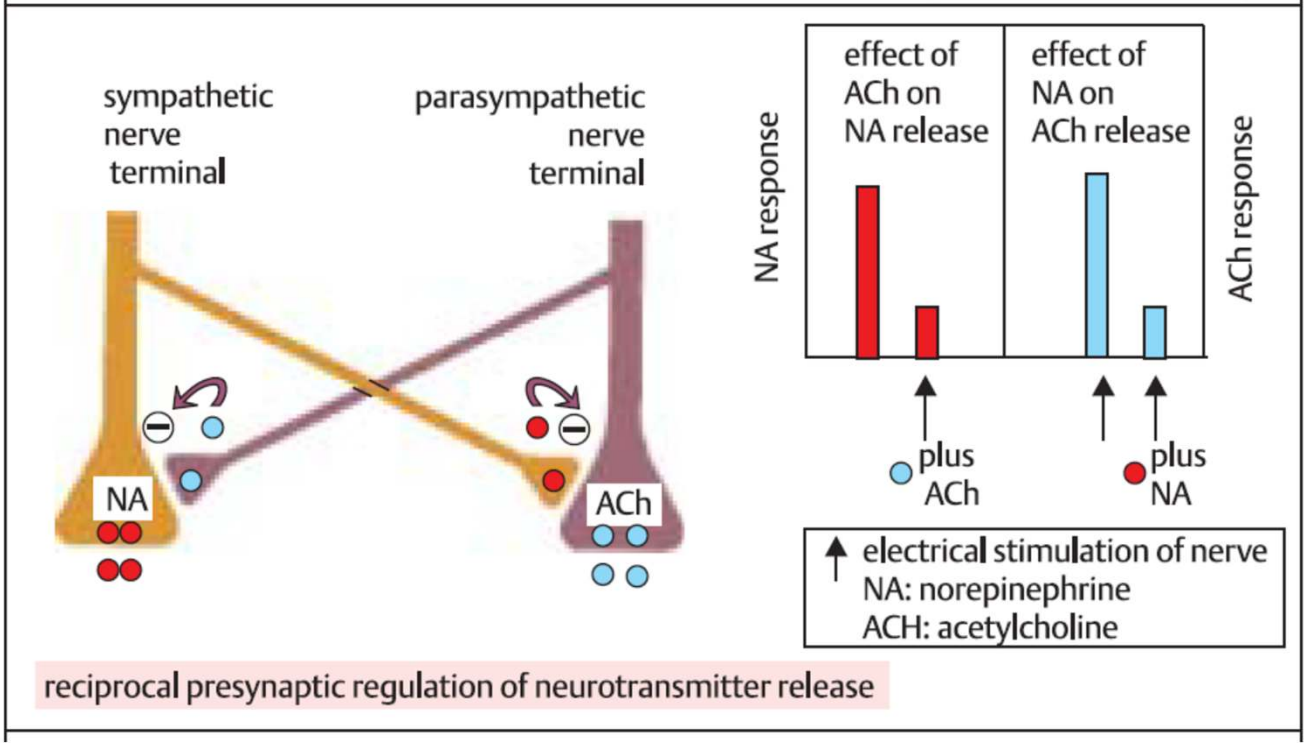

Anterior horn cell syndrome


Combined anterior horn cell-pyramidal tract syndrome (amyotrophic lateral sclerosis)


Anterior spinal artery occlusion

Reciprocal action of sympathetic and parasympathetic nerves



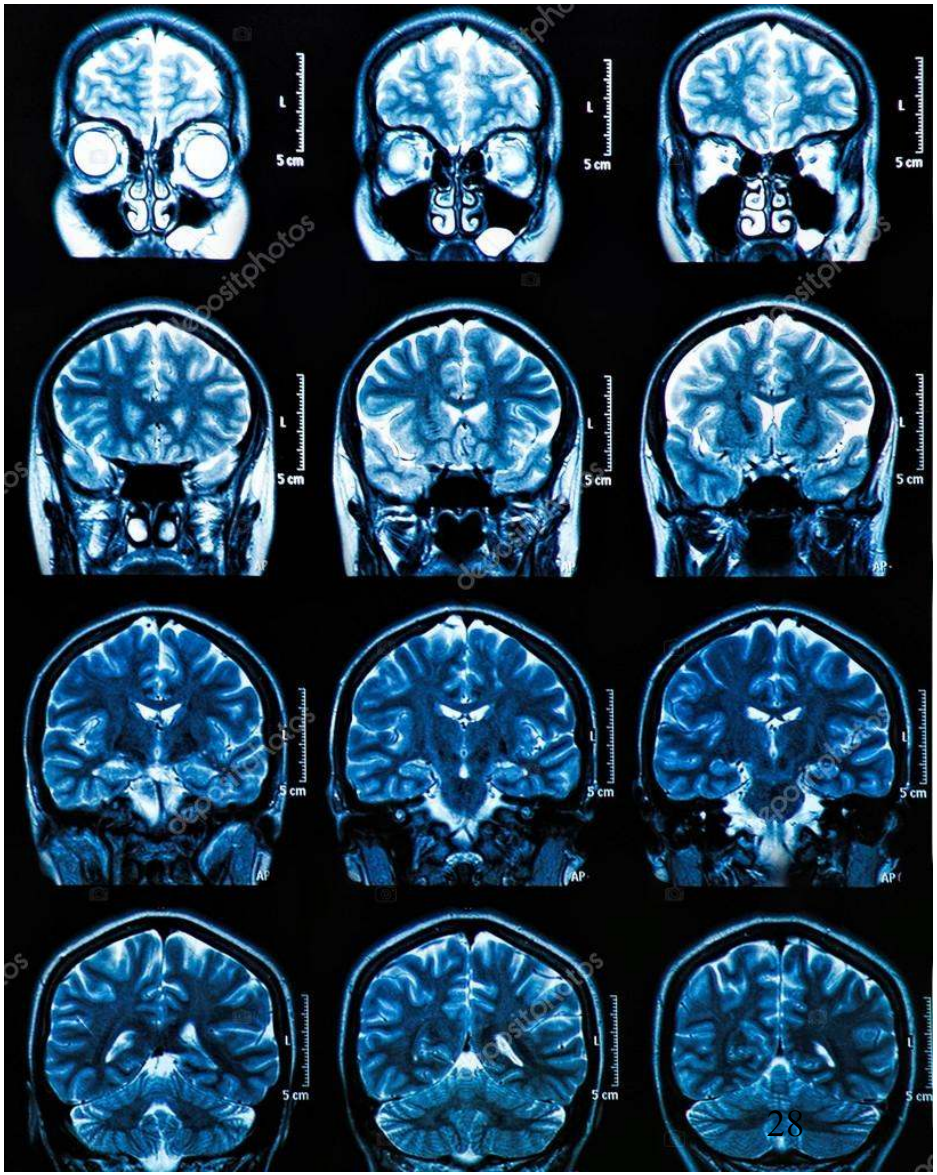


Other examinations

- lumbar punction
- radiodiagnostics
- isotope methods
- USG + Doppler
- Angiography,

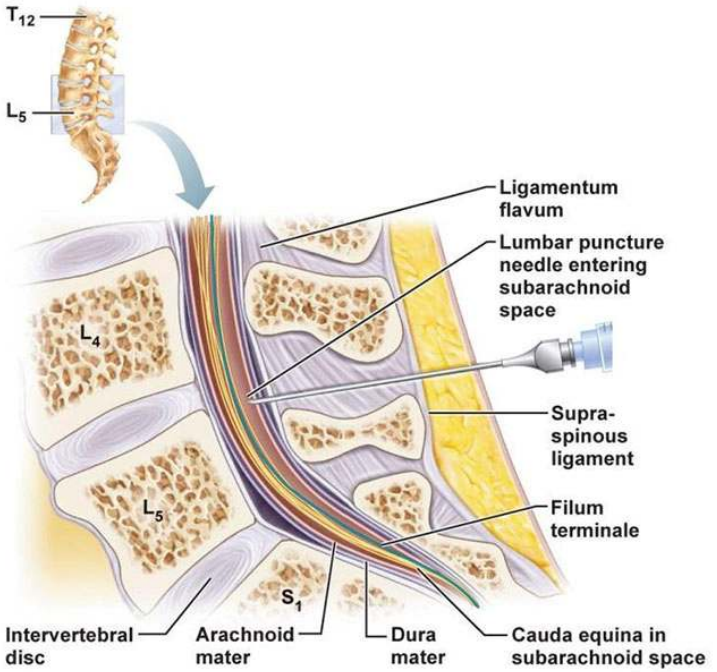
digital subtraction A.

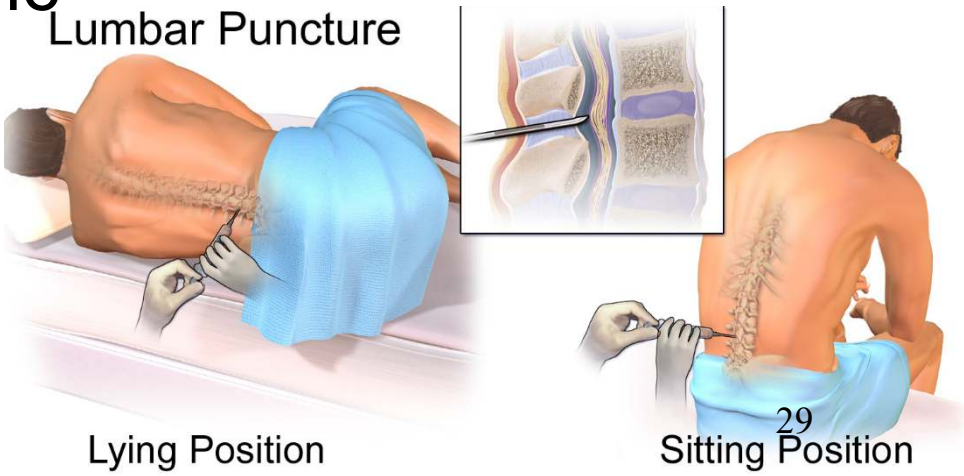
- EEG
- sleep examination
- evocated potencials
- laboratory methods
- meningeal signs
- ventriculography
- pneumoencephalography
- …



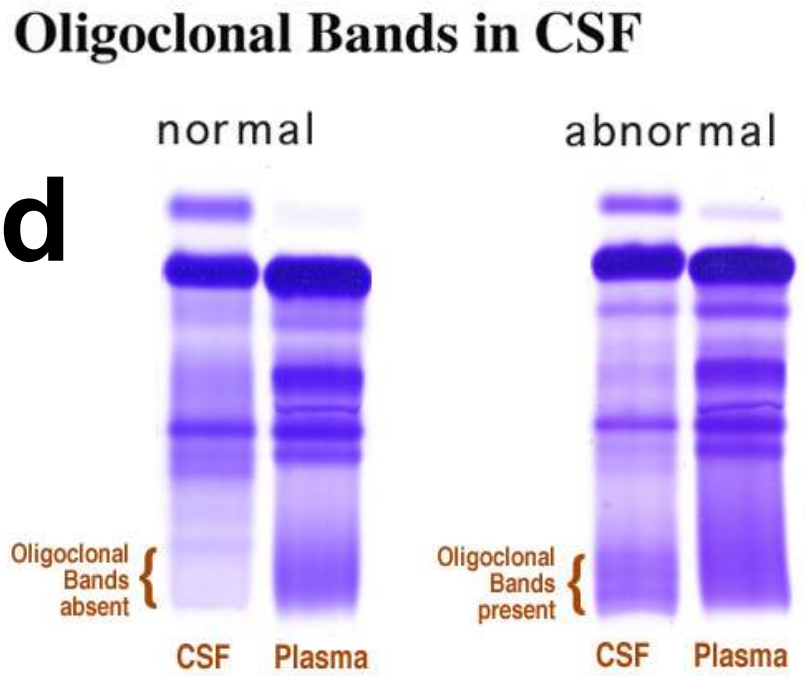
Lumbar punction

- **indications**: diagnostics of neuroinfections, demyelinization diseases, tumours, ruling out intracranial hemorrhages
- **contraindications**: high intracranial pressure, expansive intracranial processes, sepsis, local infection, hemorrhagic diateses, vertebral deformities
- postpunction syndrome





Findings in cerebrospinal fluid



Typical CSF Findings in Meningitis					
Type	**Appearance**	**Pressure (cm H_2O)**	**WBC/mm^3** *Predom type*	**Glc (mg/dL)**	**TP (mg/dL)**
Normal	Clear	9–18	0–5 *lymphs*	50–75	15–40
Bacterial	Cloudy	18–30	100–10,000 *polys*	<45	100–1000
TB	Cloudy	18–30	<500 *lymphs*	<45	100–200
Fungal	Cloudy	18–30	<300 *lymphs*	<45	40–300
Aseptic	Clear	9–18	<300 *polys → lymphs*	50–100	50–100

Imaging Methods

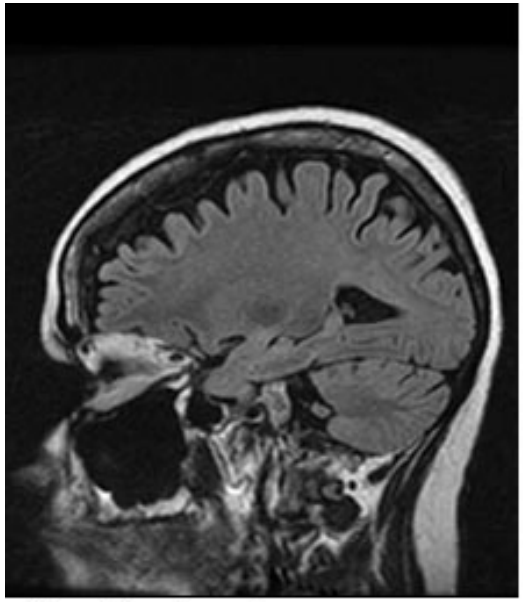
Imaging Study	Indication/Objective[1]
Conventional radiography[2] Skull, spine	Metallic foreign bodies, air-filled cavities, fractures, skull defects, bony anomalies, osteolysis, spinal degenerative disease
Computed tomography (CT) Head, spine, spinal canal, CT-guided diagnostic interventions, 3-D reconstruction	Assessment of skeleton (anomalies, fractures, osteolysis, degenerative changes, spinal canal stenosis), metastases, trauma, intracranial hemorrhage, cerebral ischemia, hydrocephalus, calcification, intervertebral disk disease, contrast studies[3] (brain, spinal canal, CT angiography)
Magnetic resonance imaging (MRI)[4]	
• Head, spine, spinal canal	• Tumors (brain, spine, spinal cord), infection (encephalitis, myelitis, abscess, AIDS, multiple sclerosis), structural anomalies of the brain (epilepsy), leukodystrophy, MR angiography (aneurysm, vascular malformation), ischemia of the brain or spinal cord, spinal trauma, hydrocephalus, myelopathy, intervertebral disk disease
• Skeletal muscle	• Muscular atrophy, myositis
Angiography[3,5] Cerebral, spinal; preinterventional or preoperative study[6]	High-grade arterial stenosis, aneurysm, arteriovenous malformation/fistula, sinus thrombosis, vasculitis
Myelography[3,7]	Largely replaced by CT and, especially, MRI. Used to clarify special diagnostic questions in spinal lesions
Diagnostic nuclear medicine	
• Skeletal scintigraphy ("bone scan")	• Tumor metastasis, spondylodiscitis
• CSF scintigraphy	• Intradural catheter function test, CSF leak
• Emission tomography[8]	• Cerebral perfusion, cerebral metabolic disorders, degenerative diseases, diagnosis of epilepsy

Imaging Methods/ Radiodiagnostics

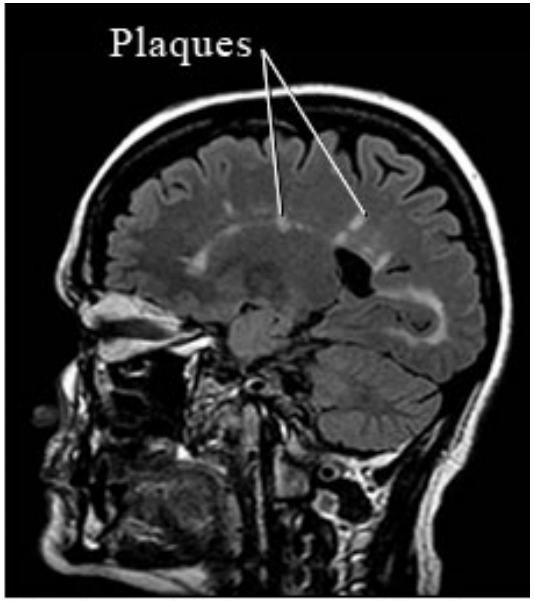
Morphological investigation methods (imaging)

- **X ray**
- **Computational tomography**
- **Positron emission tomography (PET)**
- **(Nuclear) magnetic resonance**
- **Functional magnetic resonance**
- **brain angiography**
- **Ultrasonography (USG) and Doppler sonography**

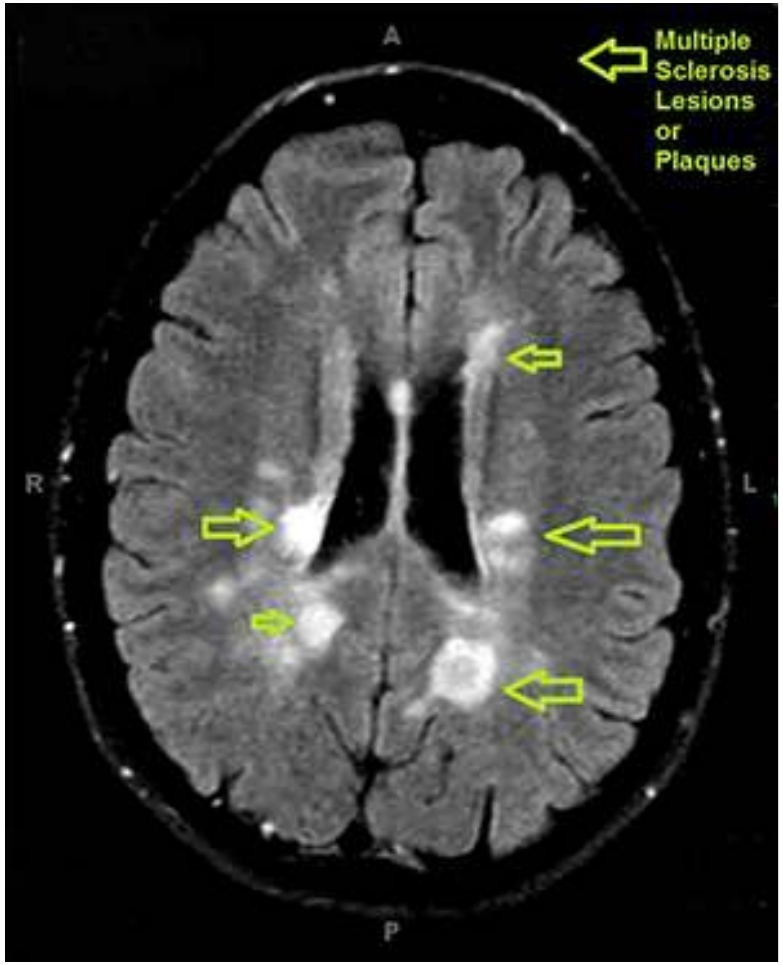
MRI (magnetic resonance imaging) example: multiple sclerosis



Healthy brain



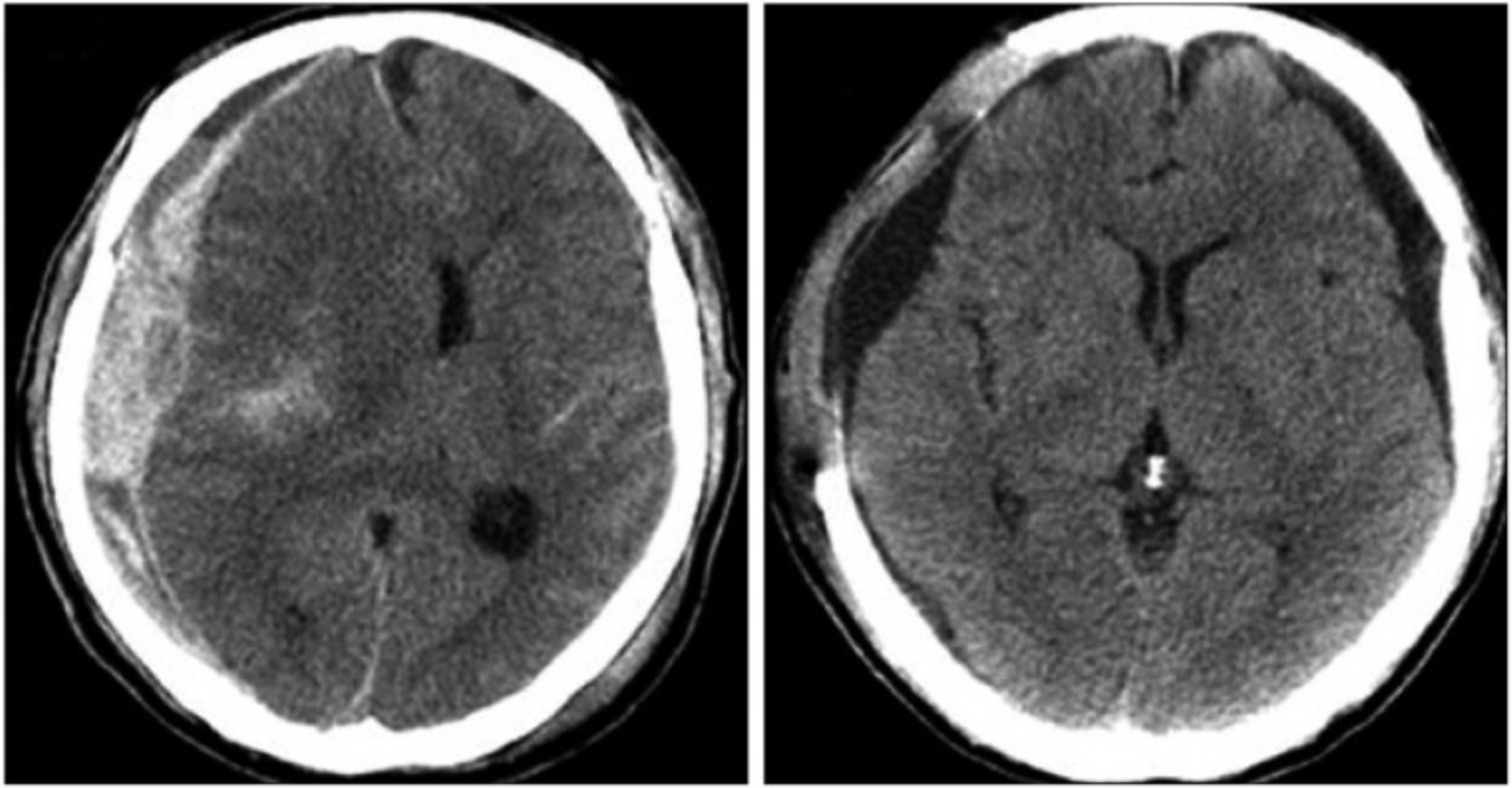
Brain with damage (lesions or plaques) caused by MS



Computer Tomography

example: acute subdural hematoma

before and after evacuation

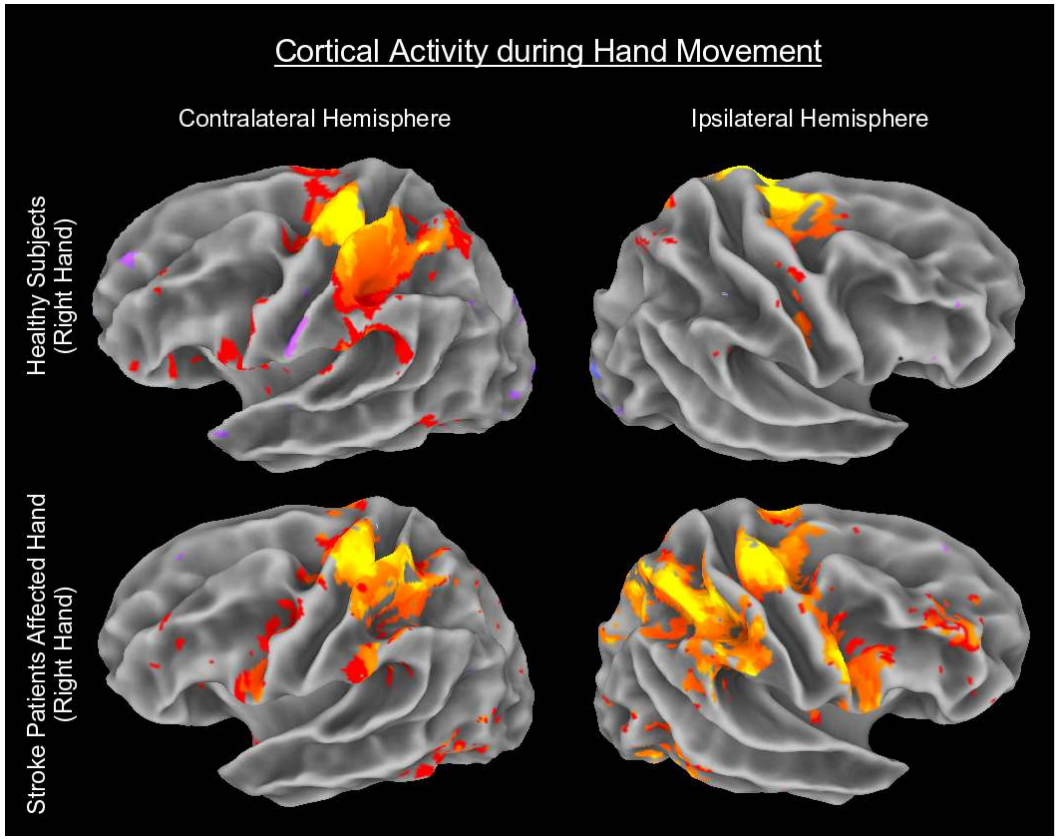


Functional magnetic resonance (f MRI)

Principle: Detects BOLD (Blood Oxygen Level Dependent fMRI) signal.

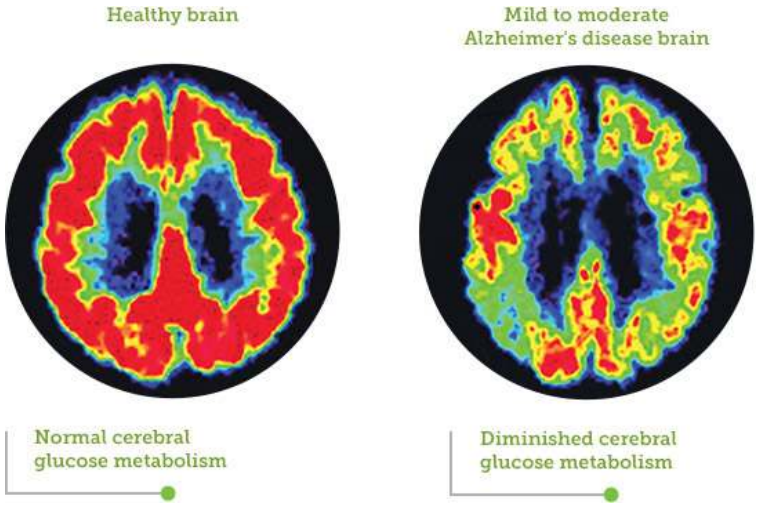
Spatial resolution: 1 mm, ***time resolution***: no theoretical limit, in practice, only times in the range of 1 s are used

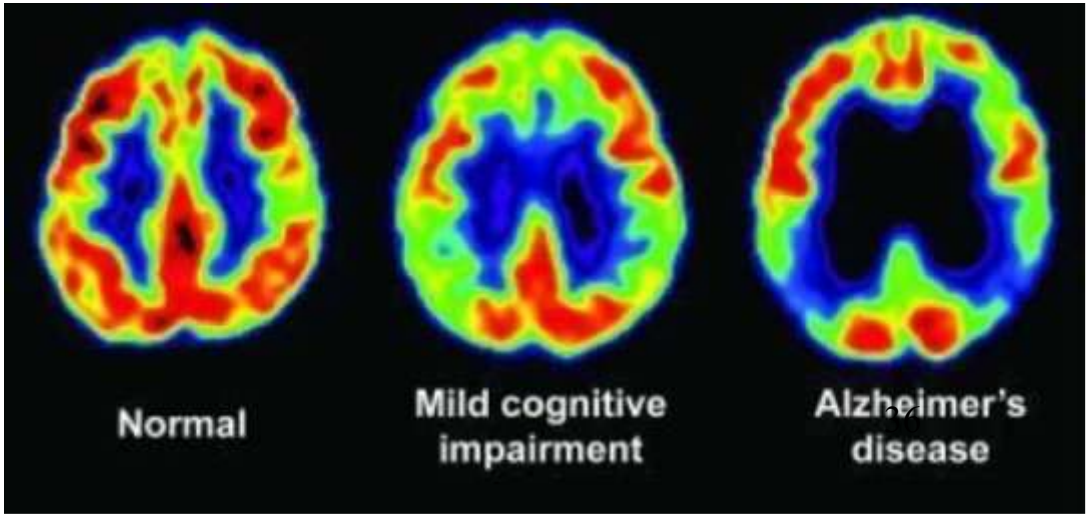
Application: Analogous, as in computer tomography. Shows a succession of areas as they are activated.



Positron emission tomography

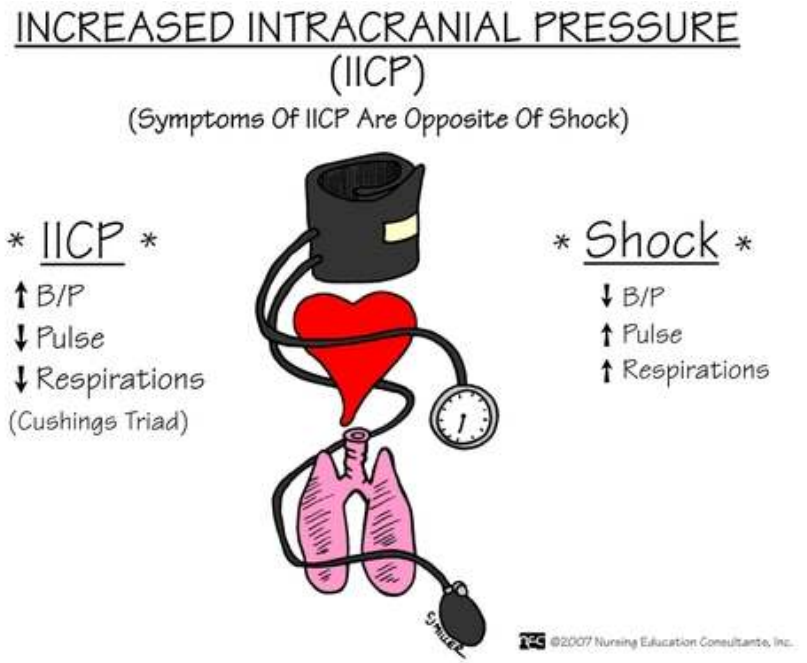
Principle: Radioactive isotopes ^{11} C, ^{13} N, ^{15} O and ^{18} F emit positrones. They collide with electrons and emit two quanta of gamma rays.
Spatial resolution: 8 mm, ***time resolution***: no theoretical limit, in practice, only times in the range of 1 s are used.
Application: Application of radioactive deoxy-glucose marks tissues with active metabolism.

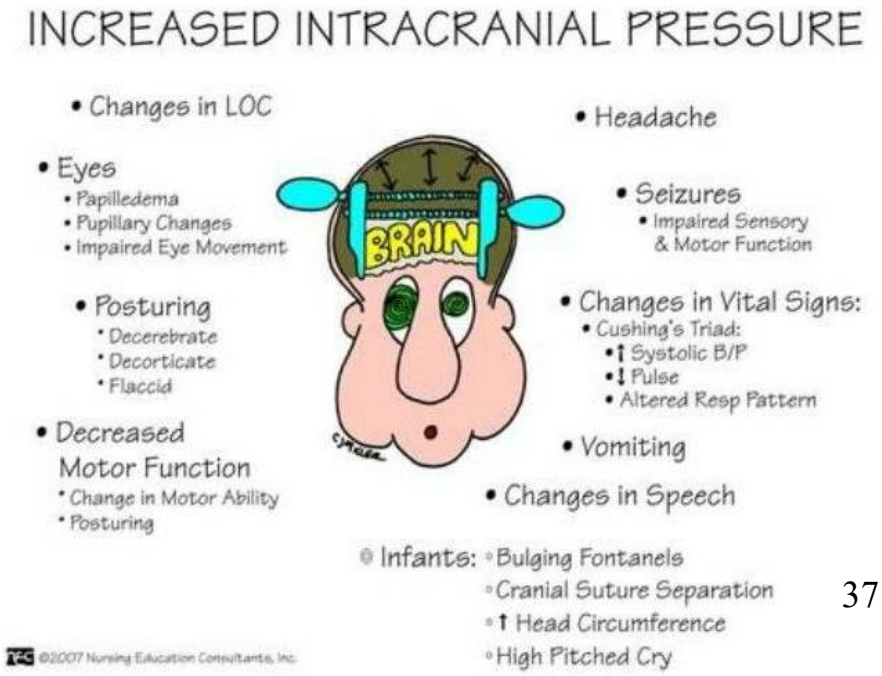




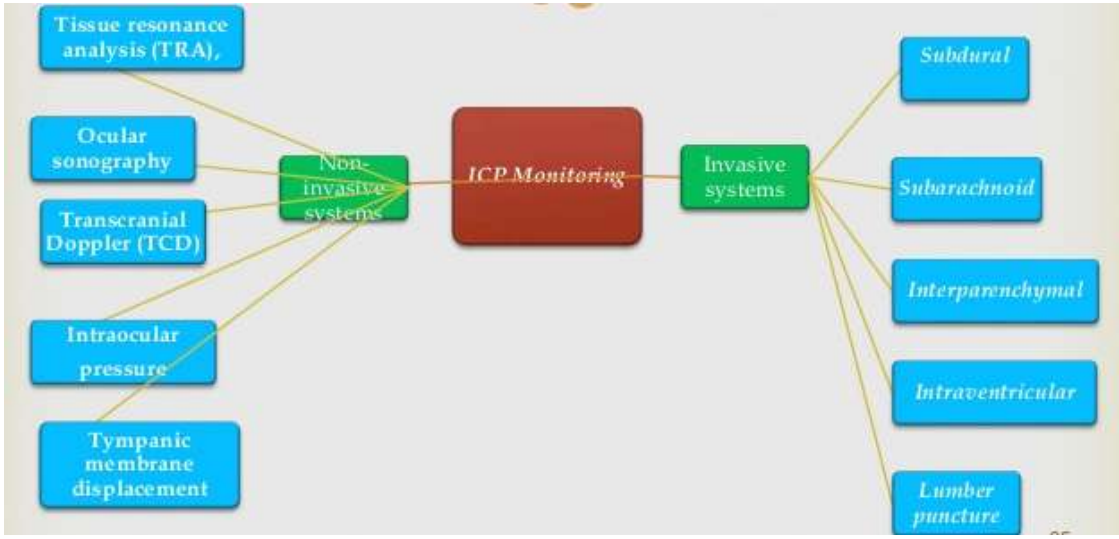
High intracranial pressure

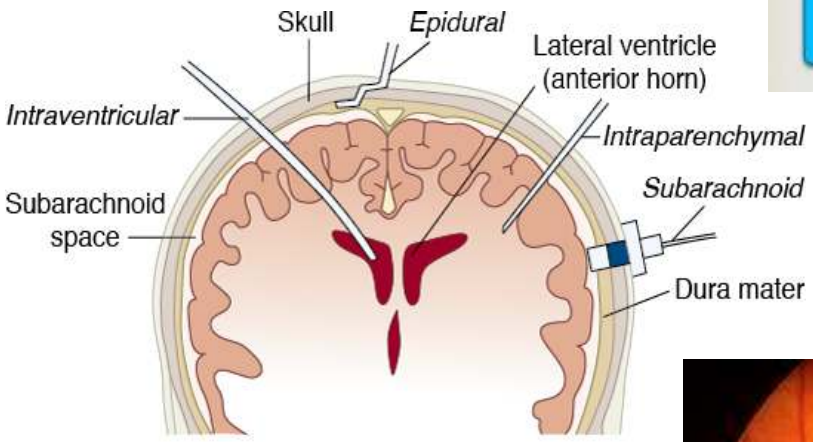
- causes:
  - intracranial bleeding
  - infections, abscesses
  - tumours, metastases
  - brain oedema
  - hydrocephalus





Intracranial pressure monitoring



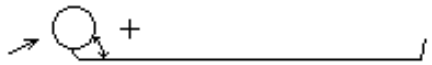


Source: Atchabahian A, Gupta R: *The Anesthesia Guide*
www.accessanesthesiology.com

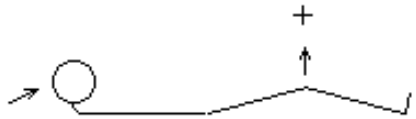
Retinography:
normal papilla vs papillary oedema in high ICP

Meningeal signs

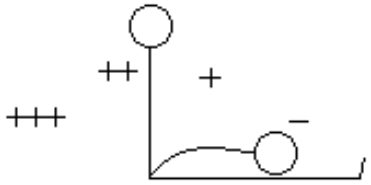
- irritation of the meningae
  - neuroinfection
  - subarachnoid hemorrhage
  - tumors on meningae
  - lesions of nearby brain tissue



nuchal rigidity

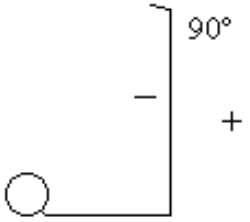


Brudziński´s sign

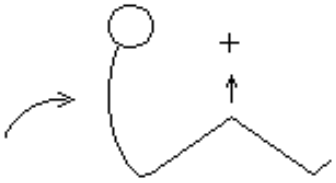


spine sign

tripod sign (Amoss´ sign)

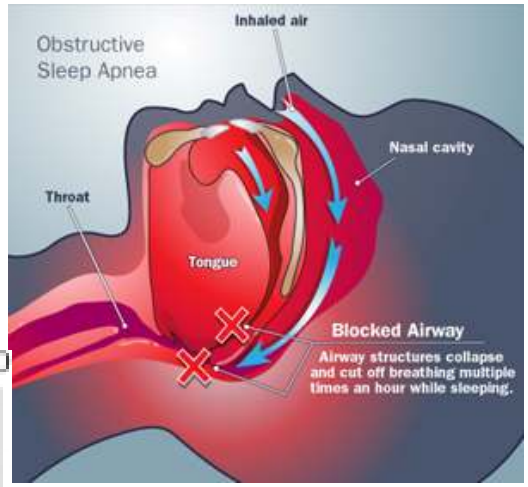


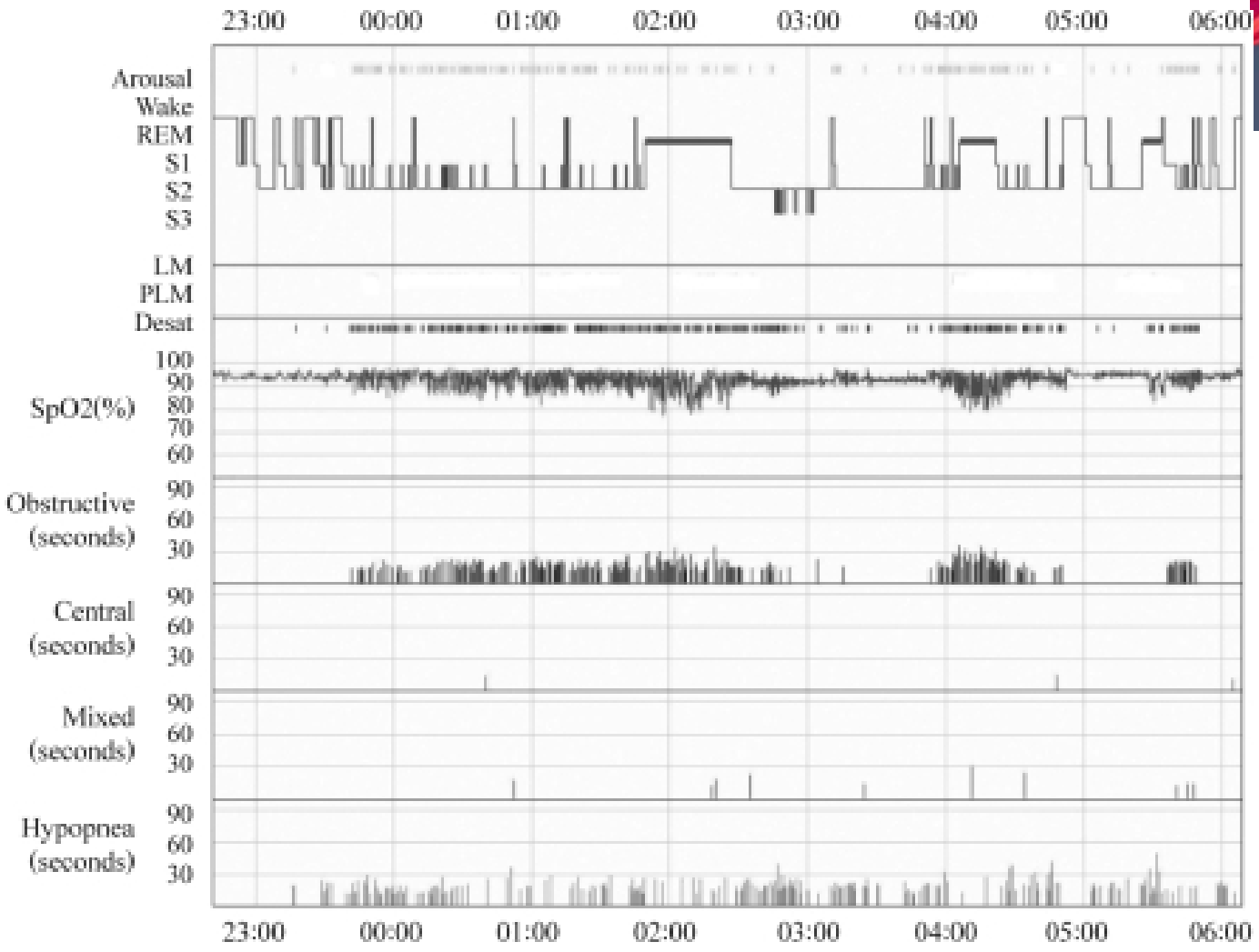
Lasègue´s sign



Kernig´s sign

Sleep examination – sleep apnea





https://openi.nlm.nih.gov/detailedresult.php?img=PMC2848777_pi-7-75-g001&req=4

Electrophysiologic Examinations

Test/Purpose	Risks	Comments
Electroencephalography: To assess electrical activity of the brain[1]	Surface electrodes: none Needle electrodes: infection Induction of seizures by provocative methods[2]	Sphenoid, subdural or depth recording[3] for special questions relevant to the (preoperative) diagnostic evaluation of epilepsy
Evoked potentials (EPs): • VEPs[4]: Study of optic nerve, optic chiasm and optic tract • AEPs[5]: Study of peripheral and central segments of the auditory pathway[6] • SEPs[7]: Study of somatosensory systems[8] • MEPs[9]: Study of corticospinal motor pathway	• None • None • None • May induce epileptic seizures. Contraindications: cardiac pacemakers, metal prostheses in the target area, pregnancy, unstable fractures	• Used mainly to diagnose prechiasmatic lesions • Used mainly for diagnosis of multiple sclerosis, tumors of the posterior cranial fossa, brain stem lesions causing coma or brain death, and intraoperative monitoring • Used to assess proximal peripheral nerve lesions (plexus, roots) and spinal cord or parietal lobe lesions • Pyramidal tract lesions, motor neuron lesions, root compression, plexus lesions, stimulation of deep nerves, differential diagnosis of psychogenic paresis
Electromyography: Study of electrical activity in muscle	Contraindication: coagulopathy. Risk of injury in special studies[11]	Provides information on motor unit disorders in patients with peripheral nerve lesions or myopathies. Not disease-specific. Disposable needles should be used to prevent spread of infectious disease[10]
Electroneurography: Measurement of motor and sensory conduction velocities.	Needle recordings contraindicated in patients with coagulopathy	Localization (proximal, distal, conduction block) and classification (axonal, demyelinating) of peripheral nerve lesions[12]
Electro-oculography: To record and assess eye movements and/or nystagmus	Caloric testing with water contraindicated in patients with perforated eardrums	Diagnosis and localization of peripheral and central vestibular lesions. Differentiation of saccades

Electrophysiologic examinations

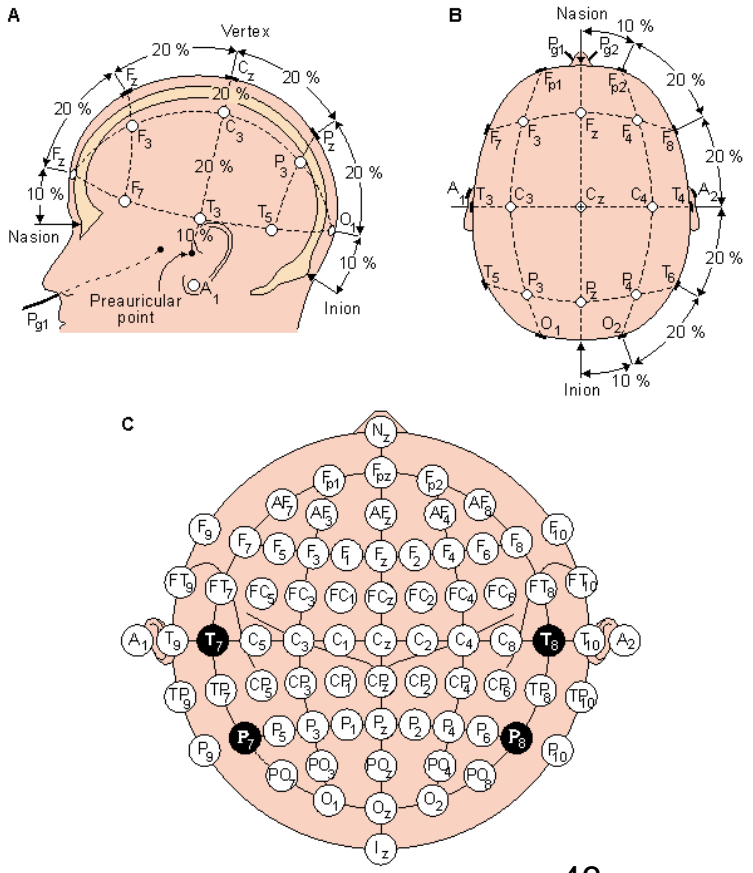
- Electroencephalography (EEG)
- Evoked potentials (EP)
- Electromyography (EMG)
- Other methods (electro-oculography, retinography, etc.)

Electro-encephalo-graphy (EEG)

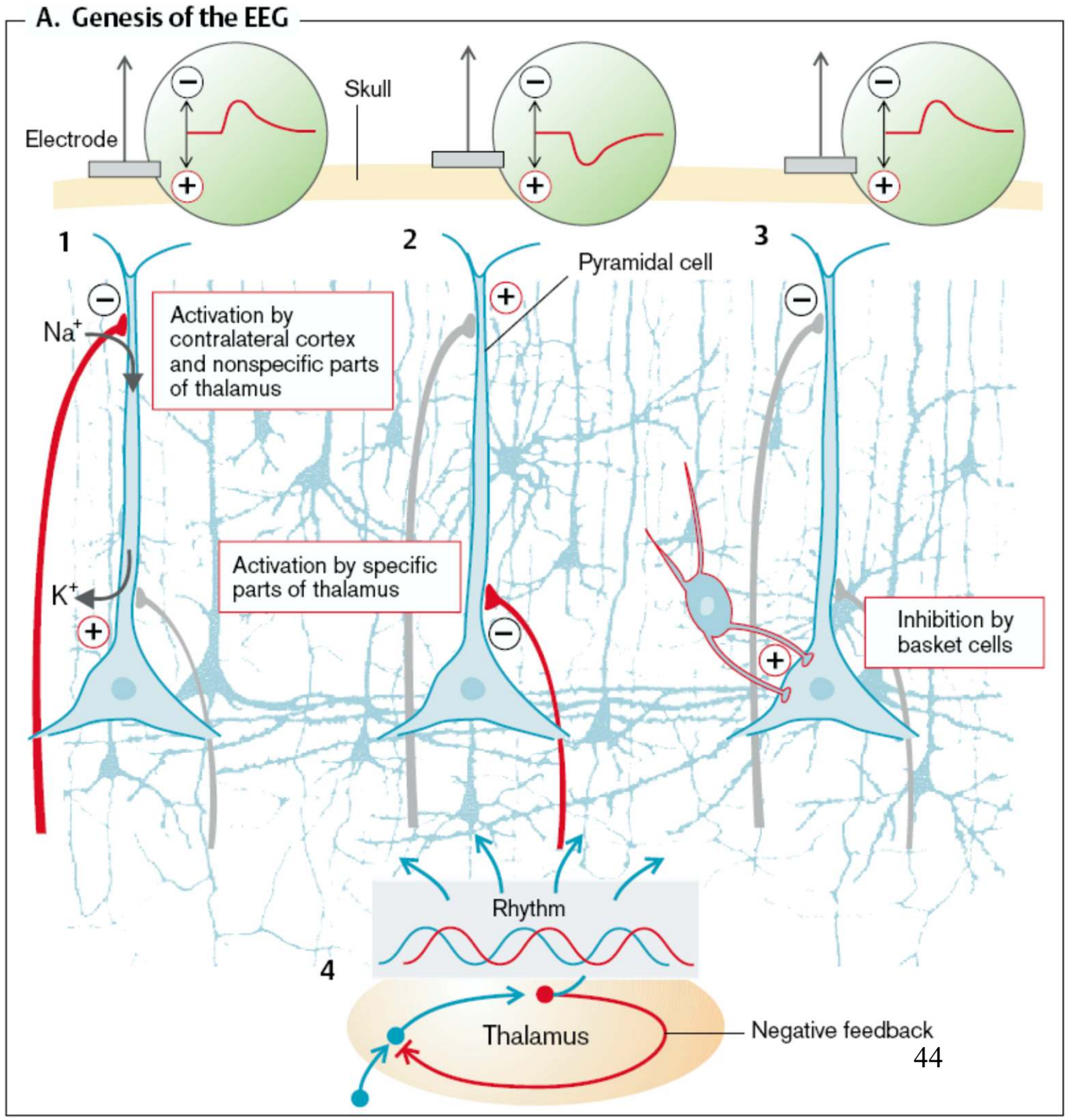
Principle: The EEG signal is result of net excitatory and inhibitory post-synaptic activity in surface layers of cerebral cortex. On the surface of the skull this is sometimes called macro-EEG, as compared to micro-EEG recorded at the cortex surface during surgeries.

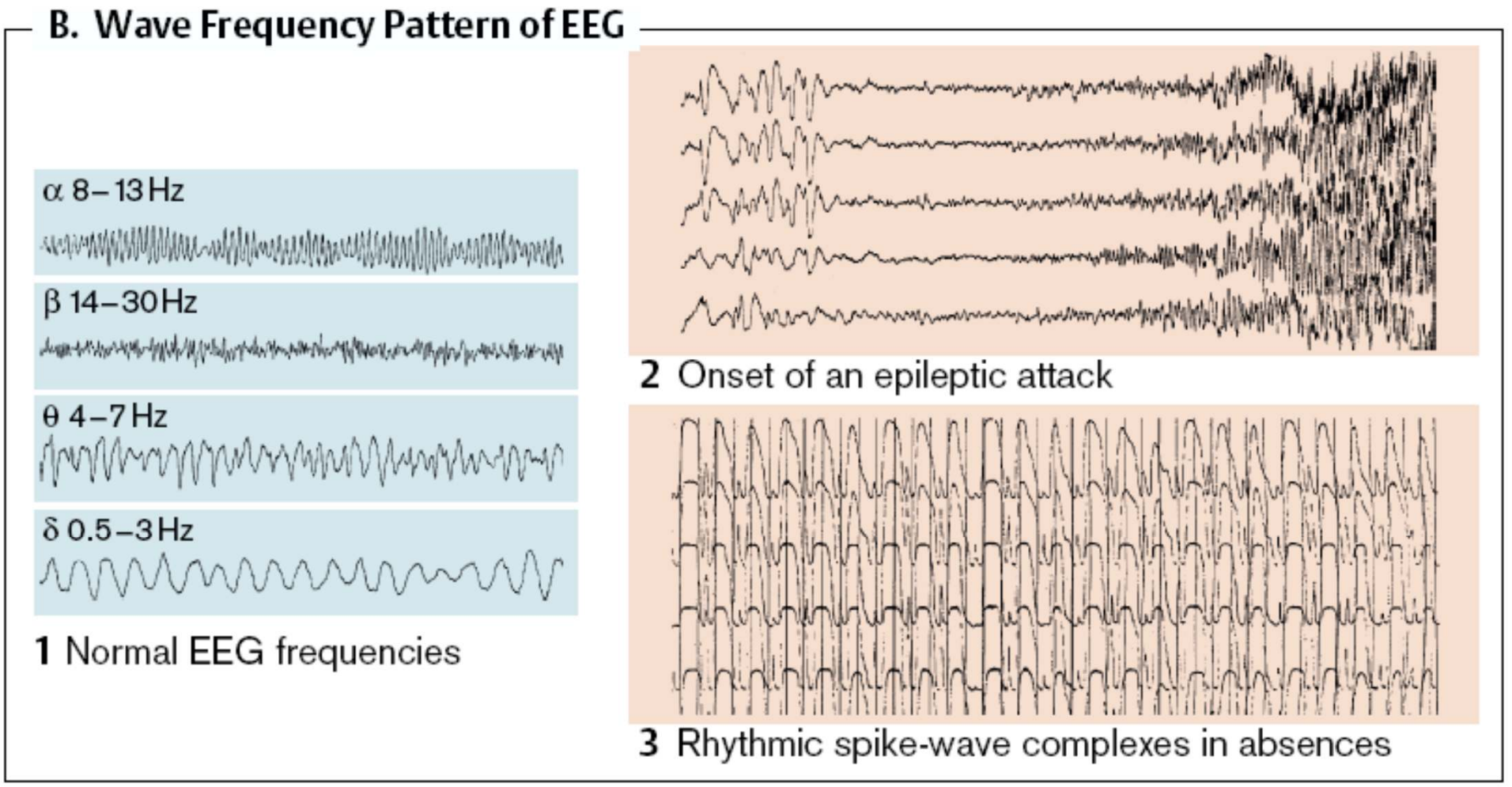
Spatial resolution: due to crosstalks coarser than 1 cm, ***time resolution***: better than in imaging, in the range of 1 ms.

Application: Epilepsy, sleep disorders, also in investigation of sensory systems.



Summation and synchronization of post-synaptic potentials in surface layers of cerebral cortex.





Normal findings: EEG waves:

Alpha waves, 8-13 Hz, parieto-occipital region, marked in closed eyes

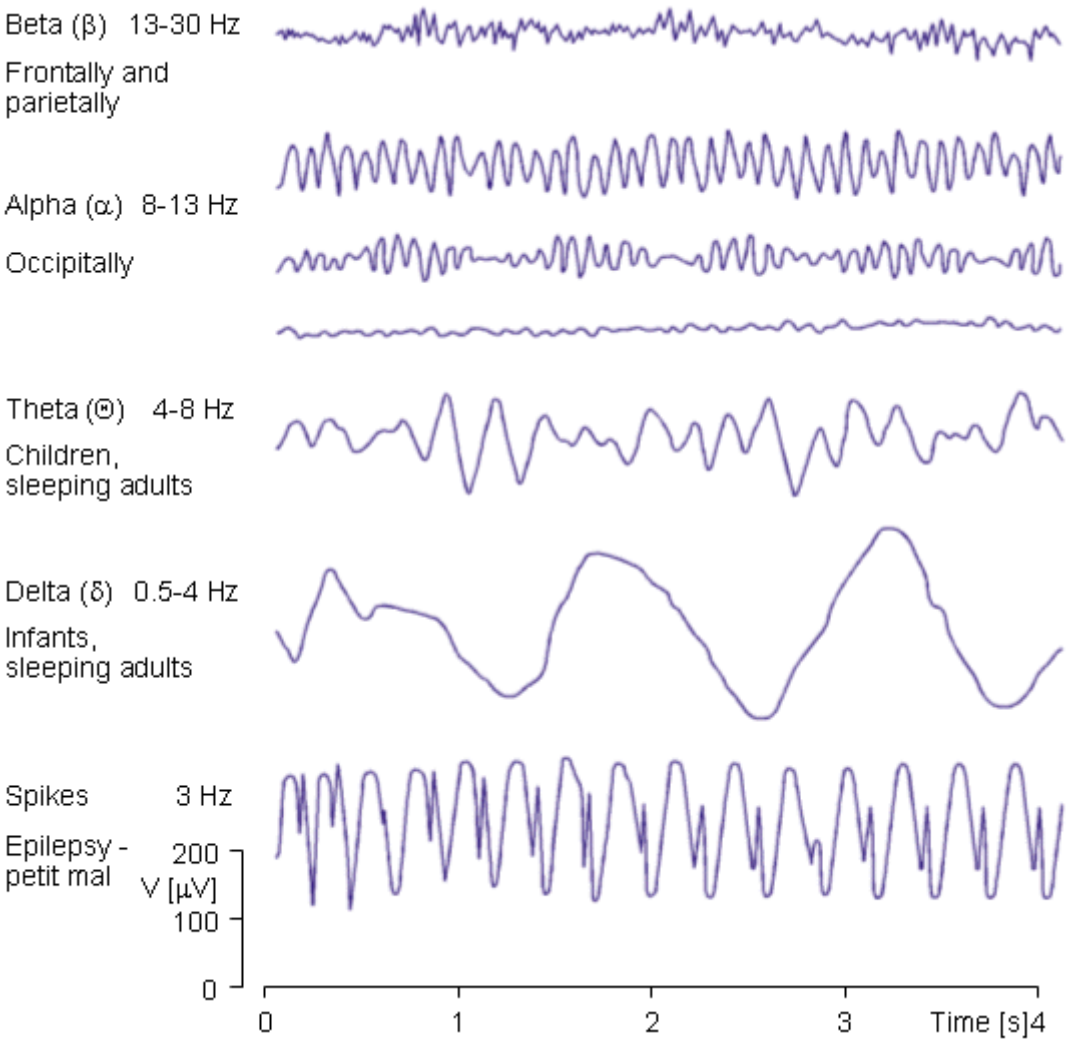
Beta waves, 14-30 Hz, frontal region

Gamma waves, 40-60 Hz, are not regularly used due to interference with electric power net.

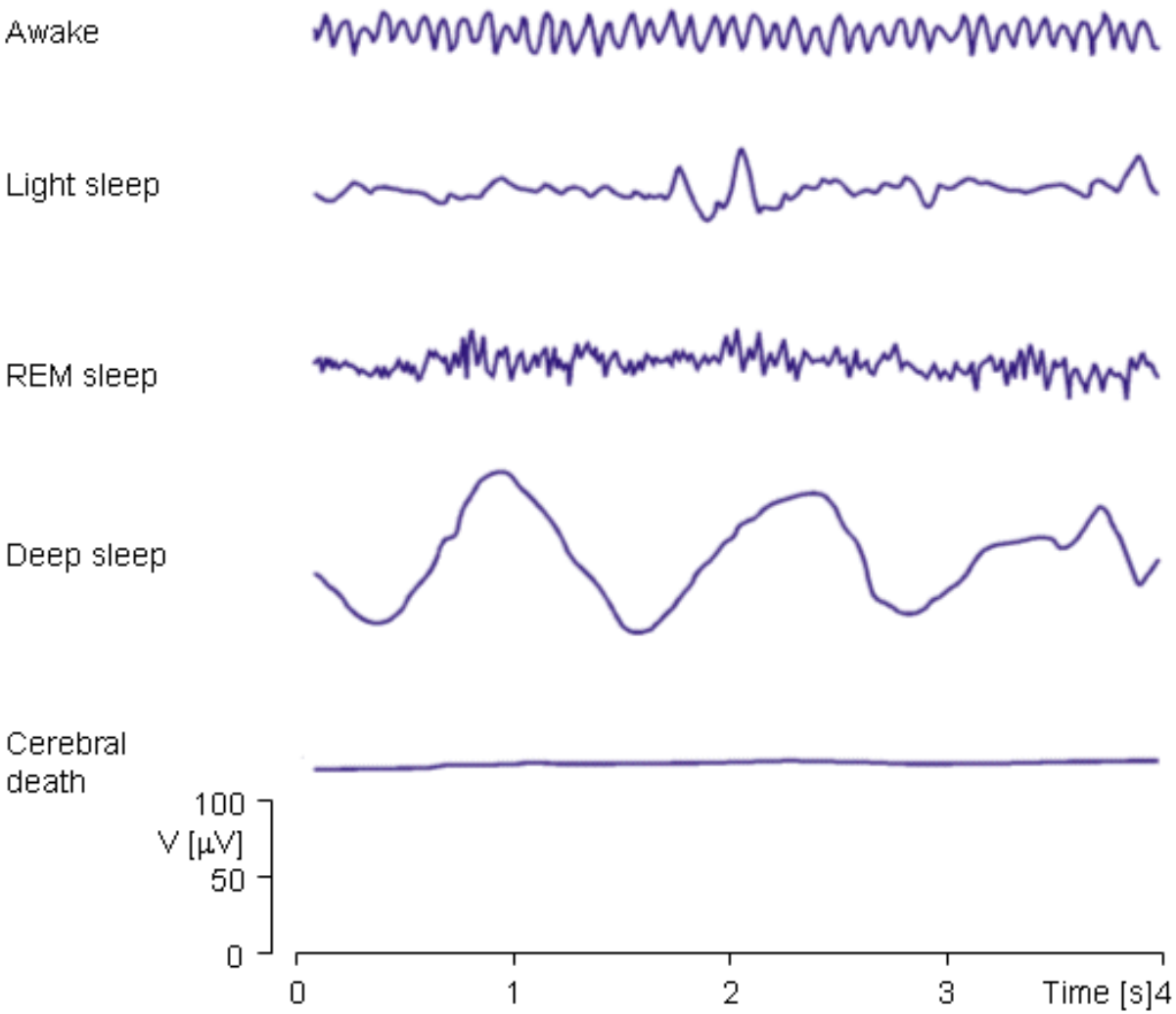
Delta waves, < 4 Hz, e.g in synchronous phase of sleep.

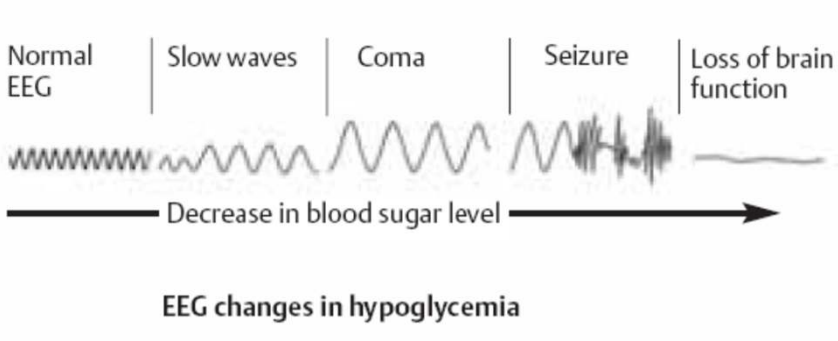
Theta waves, 4-7 Hz, e.g in synchronous phase of sleep.

EEG Waves


Beta (β) 13-30 Hz
Frontally and parietally
Alpha (α) 8-13 Hz
Occipitally
Theta (Θ) 4-8 Hz
Children, sleeping adults
Delta (δ) 0.5-4 Hz
Infants, sleeping adults
Spikes 3 Hz
Epilepsy - petit mal
200
V [μV]
100
0
0
1
2
3
Time [s]4

How can EEG look during various activities/ pathologies?





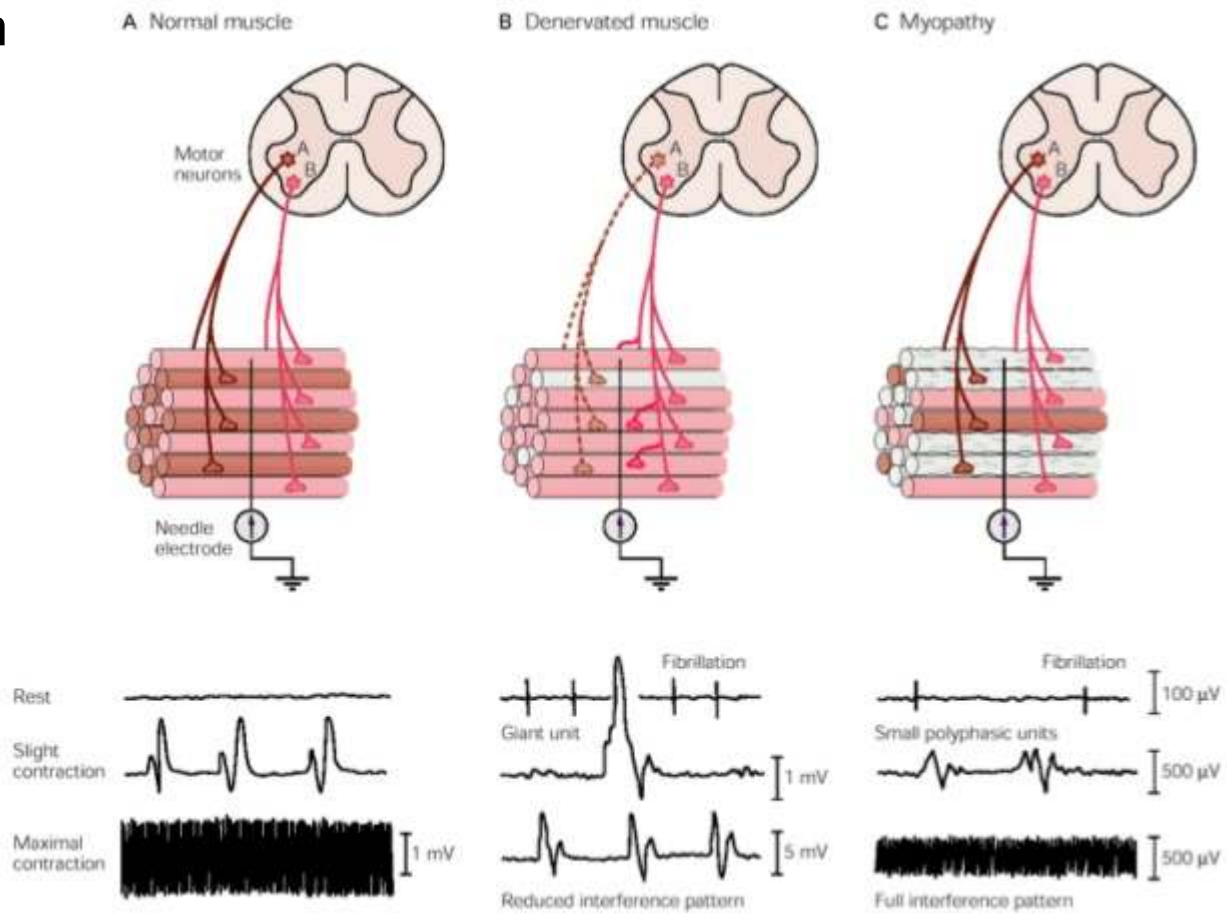
EEG changes in hypoglycemia

Electromyography (EMG)

Principle: Recording from needles, shows recruitment of muscle fibers by motoneuron stimulation, myopathies and neuropathies can be distinguished.

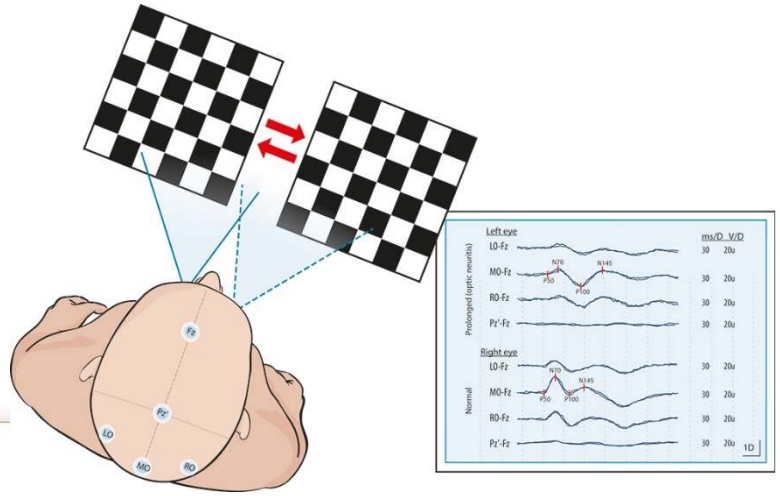
Spatial resolution, time resolution: as in EEG

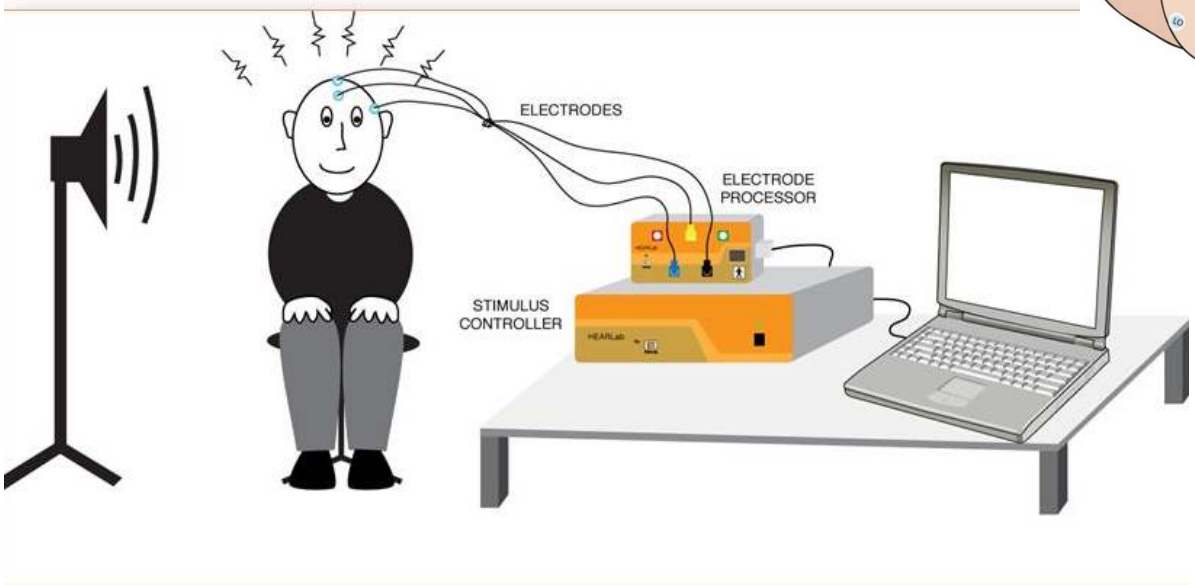
Application: Disorders of neuro-motor unit.



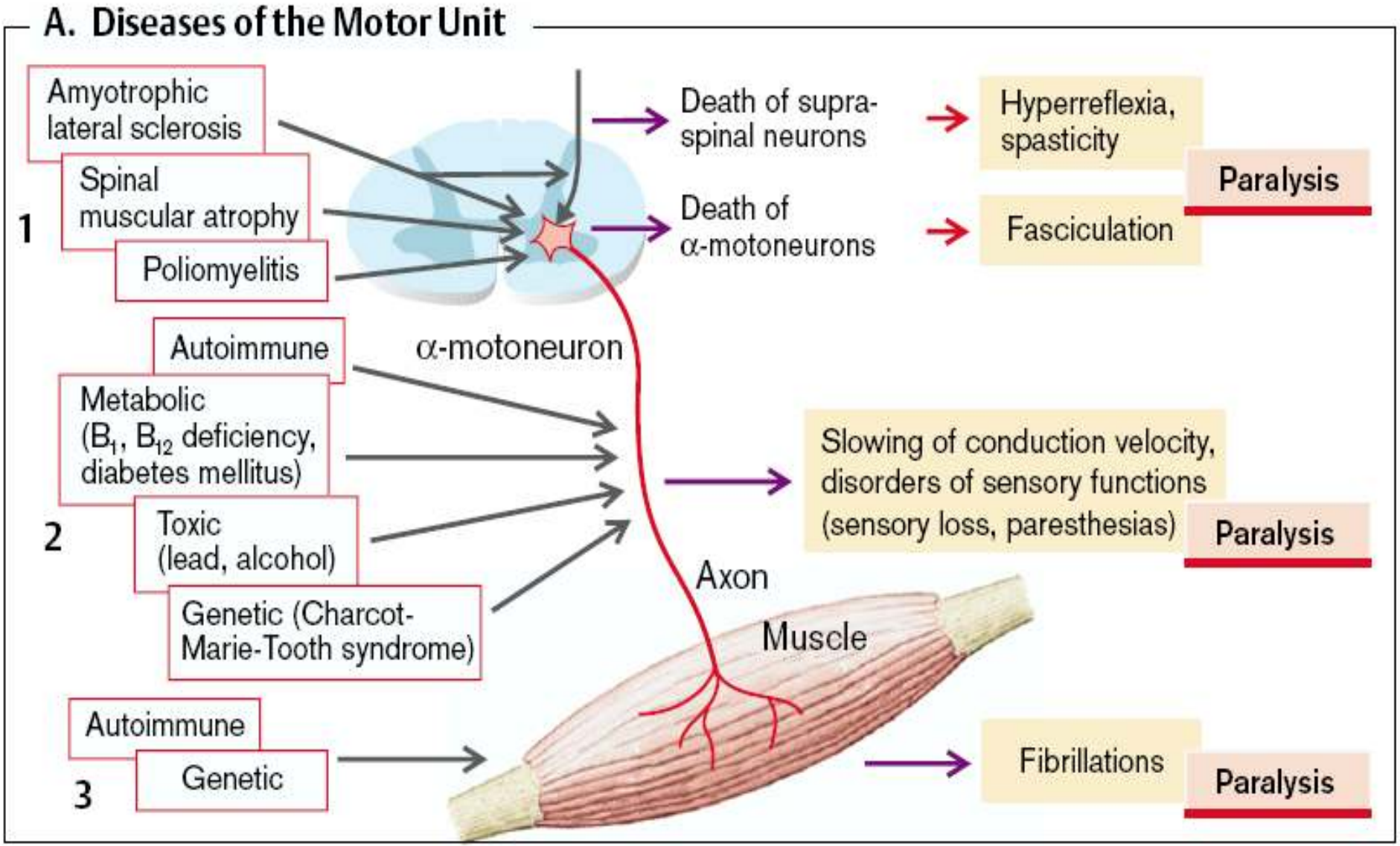
Evoked potentials

- VEP – visual
- AEP – auditory- Ear-Nose-Throat Dept.
- SEP – somato-sensoric
- SpEP – spinal



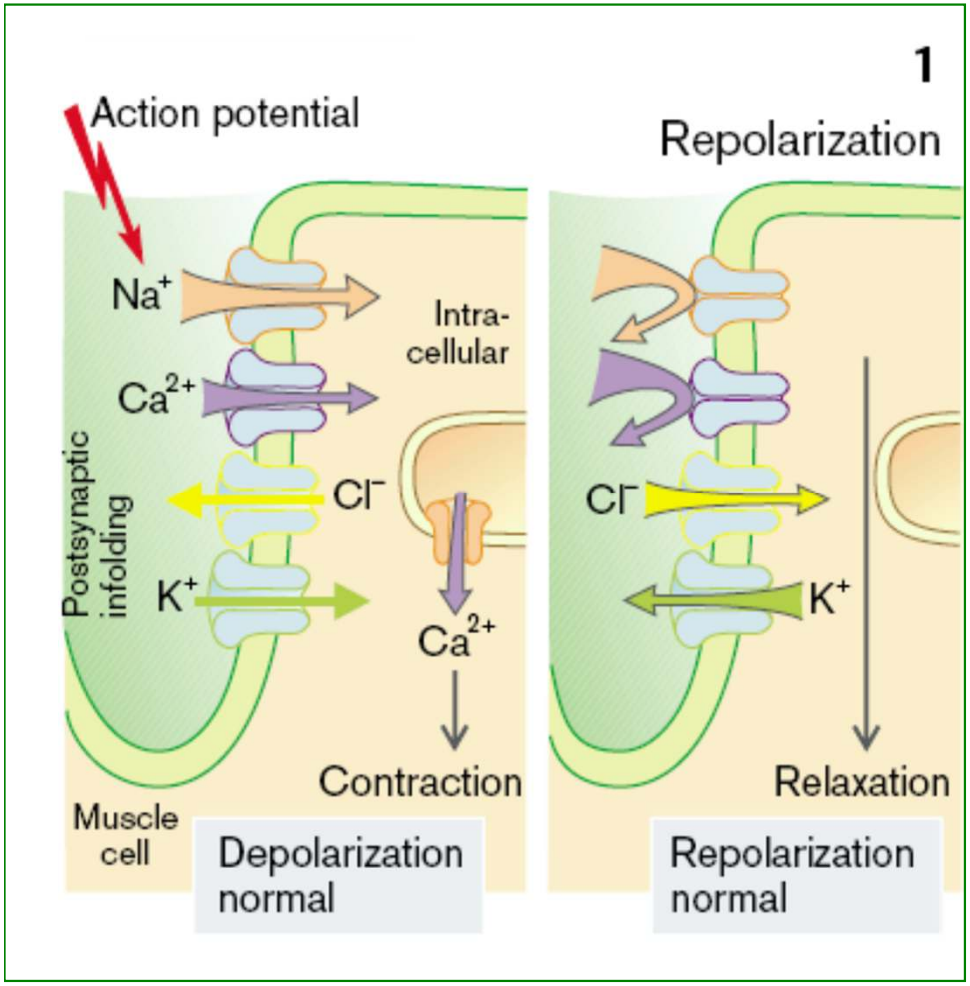


Diseases of the motor unit

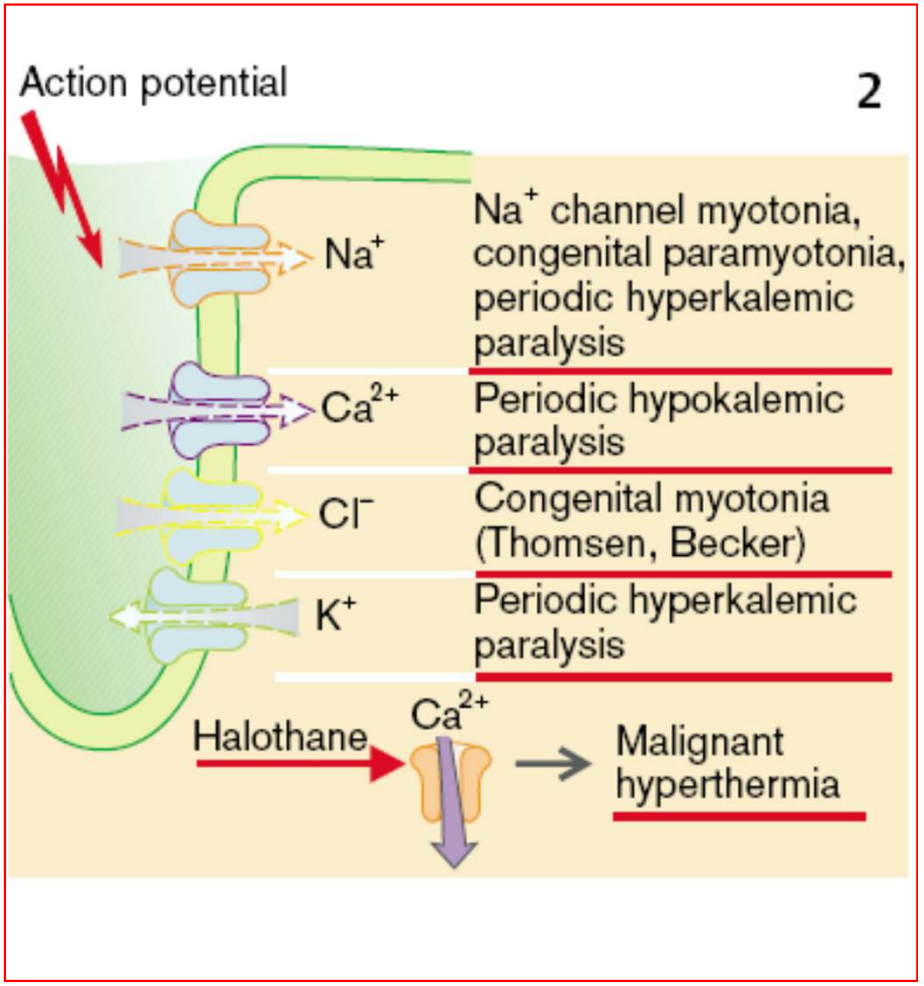


Myotonias

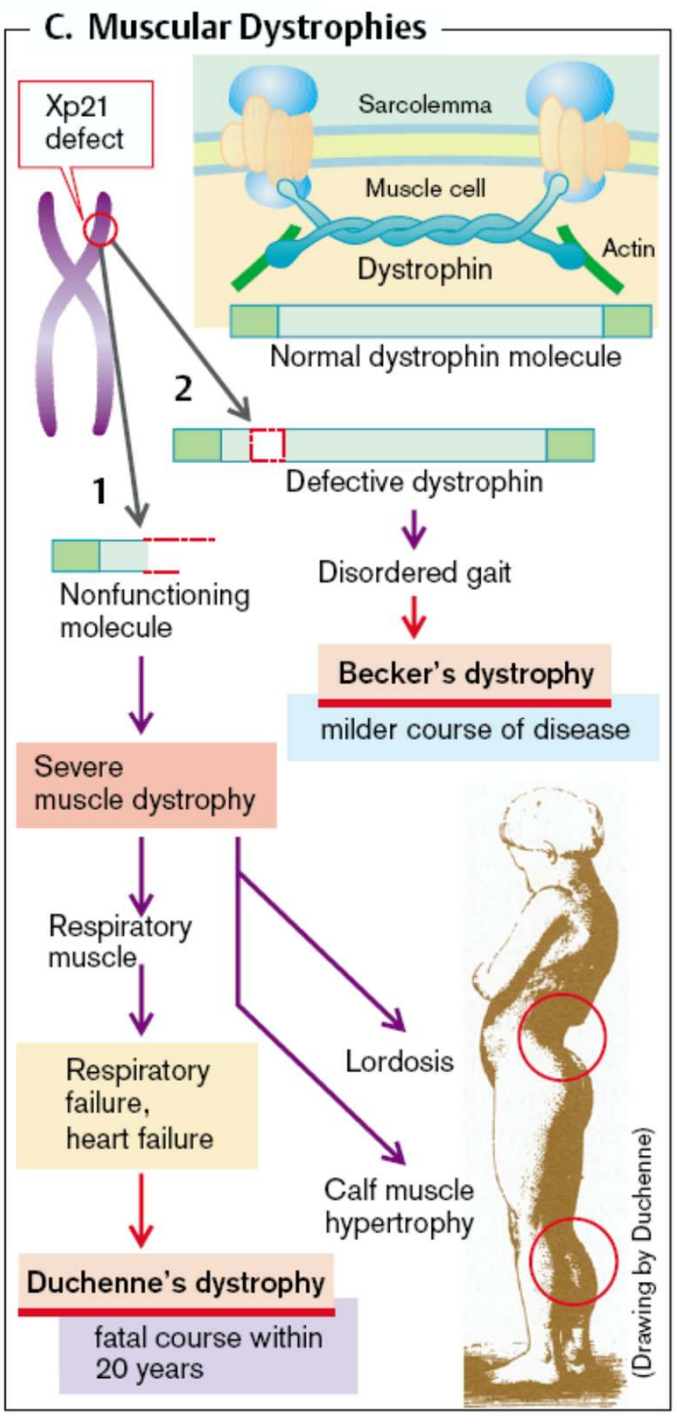
Norm



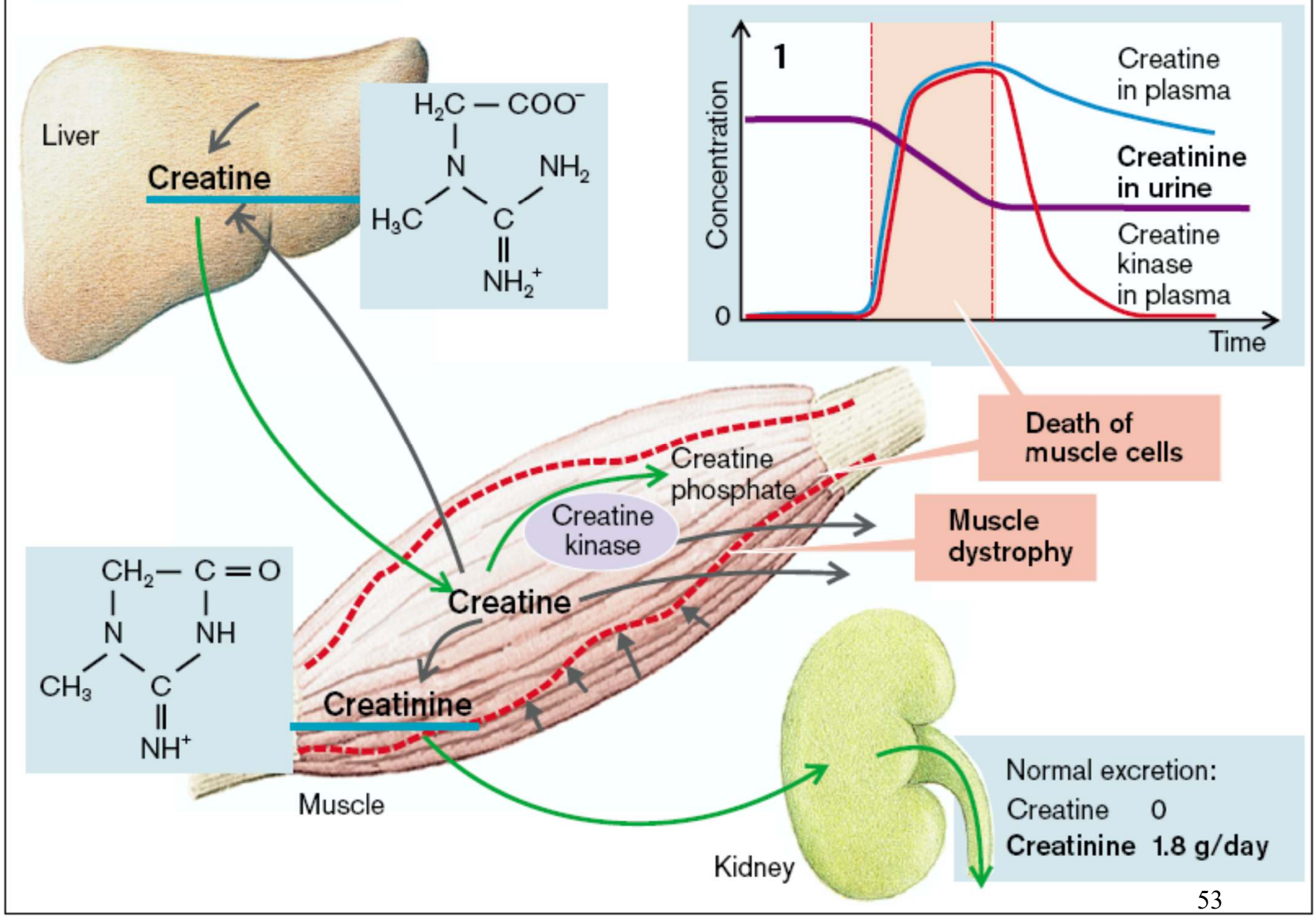
Pathology



Muscular dystrophies



E. Creatine Metabolism



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„seminar“

Petr Marsalek, and others

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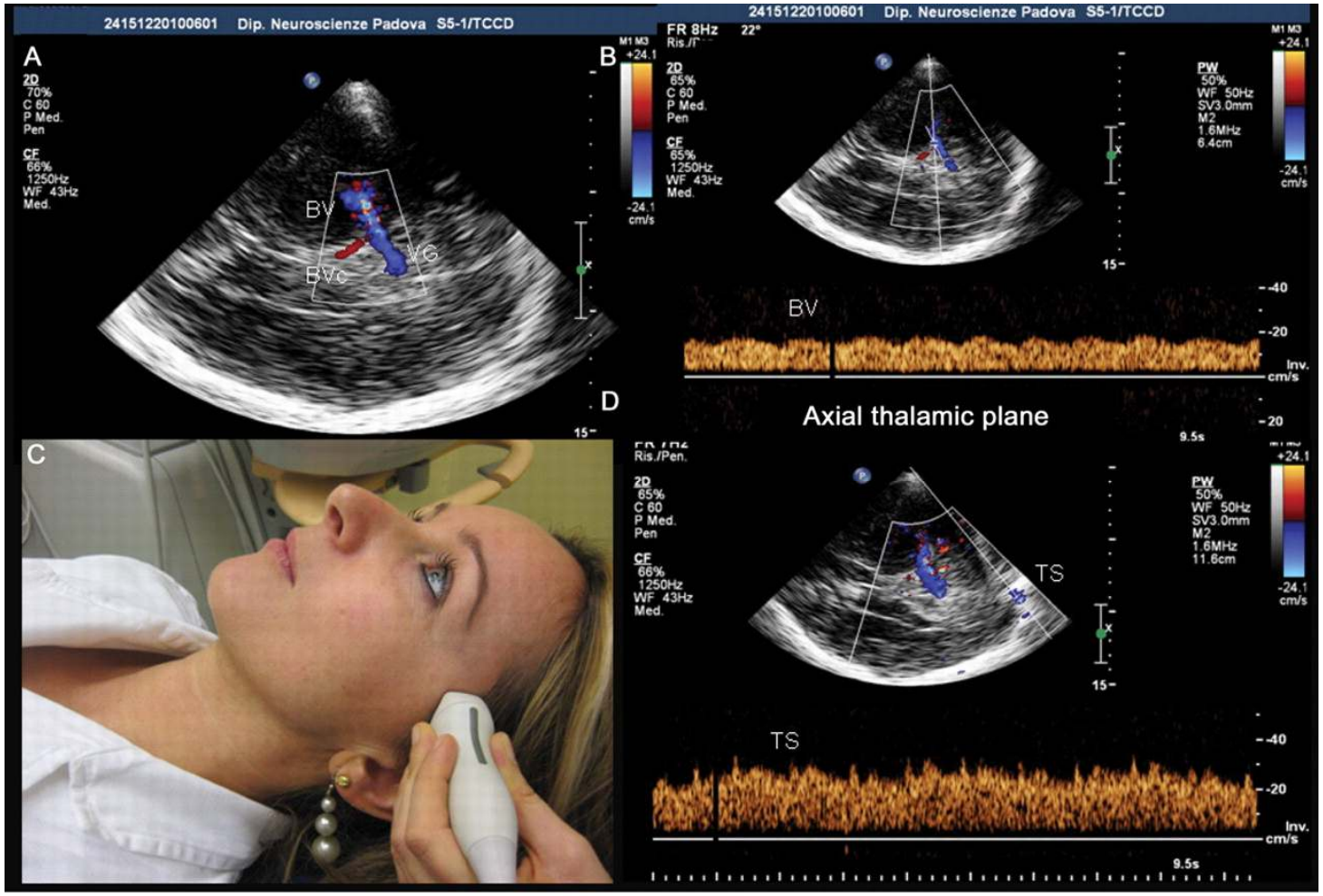
First Medical Faculty, Institute of Pathological Physiology

Transcranial Doppler USG

= ultra-sonography,shows cerebral blood flow



Venous TCDS
Transtemporal window