



NATIONAL AND KAPODISTRIAN UNIVERSITY OF
ATHENS
MEDICAL SCHOOL

Clinical examination of the nervous system

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Examination of the nervous system

Learning objectives

At the end of the lecture, participants should be able to:

1. Understand the principles of neurologic history and neurologic examination
2. Know the components of the neurologic examination
3. Be able to perform a full neurologic examination



Neurologic examination

Purpose

- The purpose of the neurologic examination is to establish whether the patient's brain, special senses, spinal cord, peripheral nerves, and muscle and skin receptors are functioning normally.
- While doing the examination, clinicians should relate findings to anatomic structures in the nervous system.
- The neurologic examination begins as soon as the clinician sees the patient and continues during history taking.
- Abnormal or unusual speech, difficulty understanding, incoordination when performing complex actions, abnormal postures or spontaneous movements, and neglect of space may be apparent before formal testing.



The neurologic method

- The purpose of the neuro exam is:
- **first, localize the lesion(s) !**
- *A basic knowledge of neuroanatomy is necessary to interpret the examination...*
- **then, define the pathophysiology**



Neuro exam

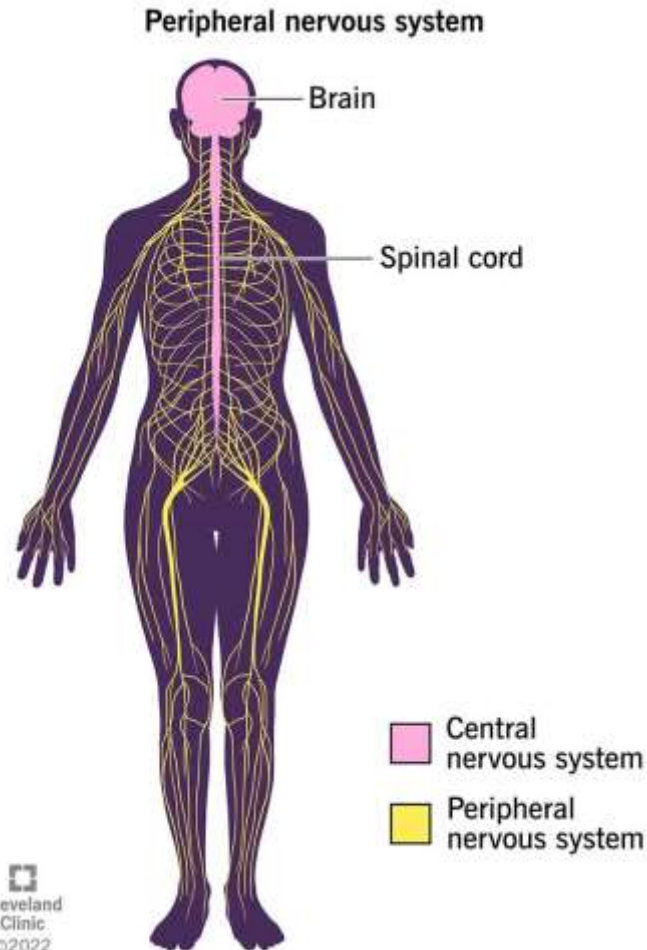
The tools





Basic concepts

Central vs. peripheral nervous system






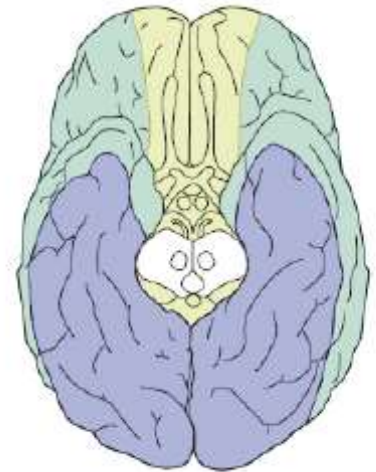
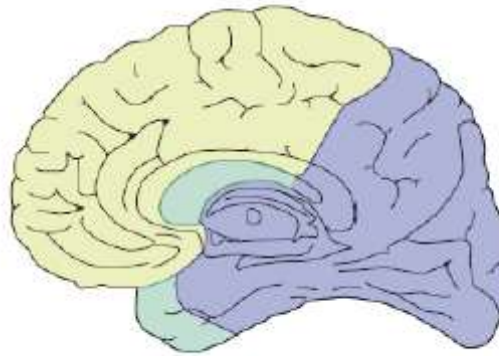
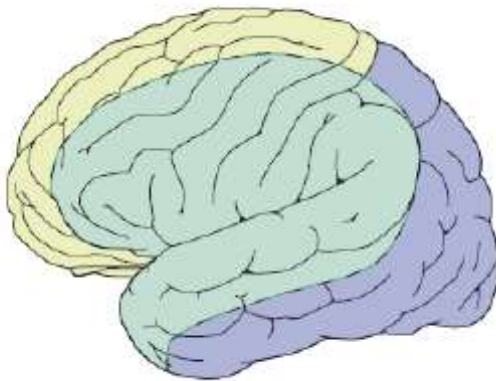


Basic concepts

Blood supply of the brain

- Cerebral Arteries – Cortical Distribution

	Anterior cerebral artery (supplies anteromedial surface)
	Middle cerebral artery (supplies lateral surface)
	Posterior cerebral artery (supplies posterior and inferior surfaces)

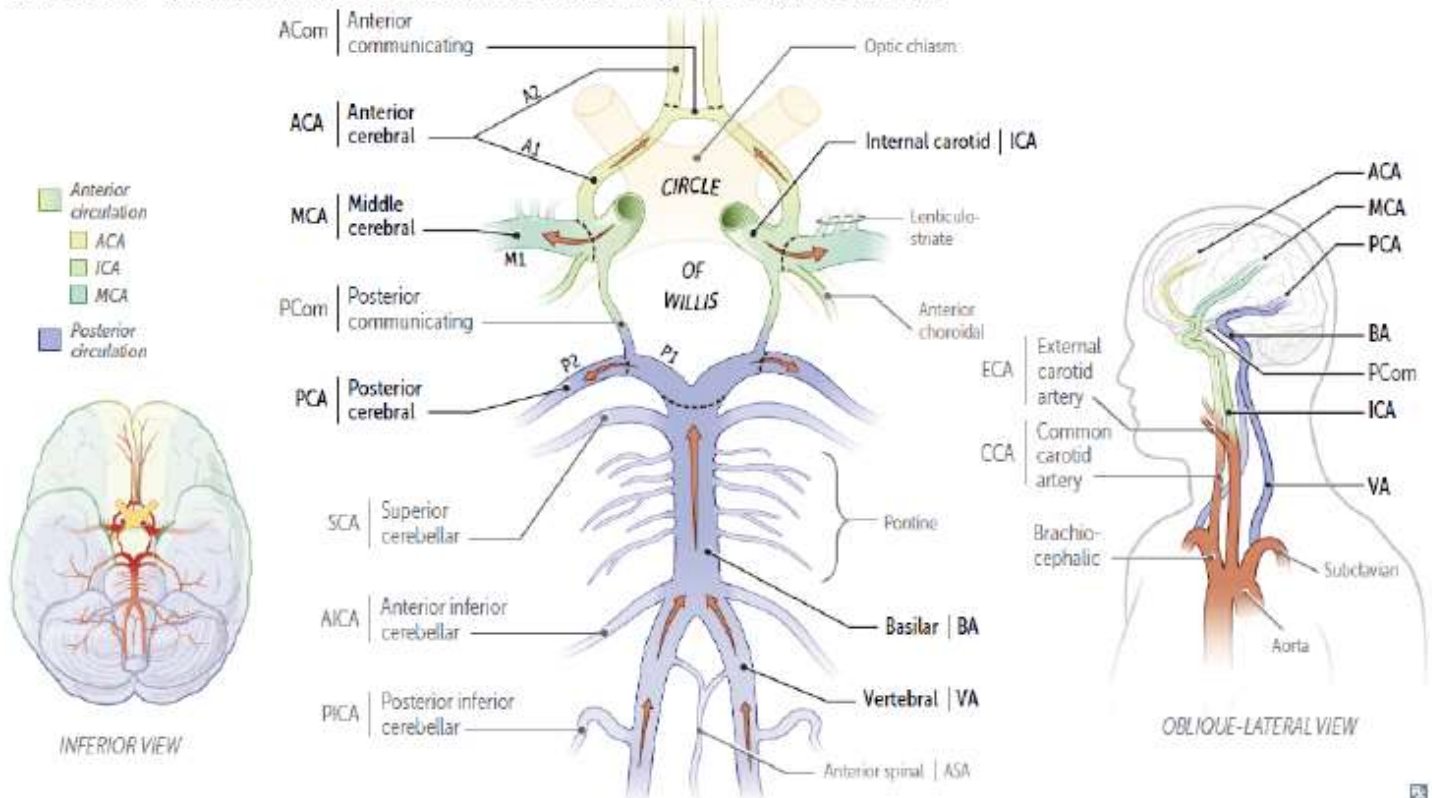




Basic concepts

Blood supply of the brain

- Circle of Willis – system of anastomoses between anterior and posterior blood supplies to the brain





Neurologic examination Components

- Mental status
- Cranial nerves
- Motor system
- Muscle strength
- Gait, stance and coordination
- Sensation
- Reflexes
- Autonomic nervous system



Mental status



Mental status

The bare minimum

During the interview, look for
difficulties with communication and
determine whether the patient has
recall and insight into recent and
past events



Mental status examination

Individual elements

- Level of consciousness
 - Fully awake to comatose (when not fully awake, examiner should describe the responses to the minimum stimulus necessary to elicit a response)
- Orientation
 - Who, where, when (time usually the first to be affected)
- Speech and language
 - Articulation, rate and rhythm, verbal and written output
- Memory
 - 1) Immediate; 2) Short-term, 3) Long-term
- Fund of information
 - Questions about major historic or current events
- Insight and judgment
- Abstract thought
 - Similarities between objects or concepts (apple/orange, sculpture/poetry, etc)
- Calculation ability
 - Appropriate to patient age and education



Screening for cognitive impairment

Two commonly used tests

Montreal Cognitive Assessment (MoCA)

NAME: _____ Date of birth: _____
 Education: _____ Sex: _____ DATE: _____

MONTREAL COGNITIVE ASSESSMENT (MOCA)

VISUOSPATIAL / EXECUTIVE

Copy cube (3 points)

Draw CLOCK (For past eleven) (3 points)

NAMING

FACE VELVET CHURCH DAISY BED

MEMORY

Read list of words, subject must repeat them. Do a recall after 5 minutes.

ATTENTION

Read list of digits (5 digits/sec.). Subject has to repeat them in the forward order. Subject has to repeat them in the backward order.

Read list of letters. The subject must tap with his hand at each letter A, no points if a correct.

LANGUAGE

Repeat: I only know that John is the one to help today. ()

The cat always hid under the couch when dogs were in the room. ()

Fluency / Name maximum number of words in one minute that begin with the letter P () (in 2 min words)

ABSTRACTION

Similarity between e.g. banana - orange - fruit () train - bicycle () watch - ruler ()

DELAYED RECALL

Has to recall words WITH NO CLUE

Optional: Categorizing task

ORIENTATION

Date: _____ Month: _____ Year: _____ Day: _____ Place: _____ City: _____

TOTAL _____/30

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Mini Mental State Examination (MMSE)

MINI MENTAL STATE EXAMINATION (MMSE)

Name: _____
 DOB: _____
 Hospital Number: _____

One point for each answer

DATE: _____

ORIENTATION

Year: _____ Season: _____ Month: _____ Date: _____ Time: _____

Country: _____ Town: _____ District: _____ Hospital: _____ Ward/Floor: _____

REGISTRATION

Examiner names three objects (e.g. apple, table, penny) and asks the patient to repeat (3 points for each correct. THEN the patient learns the 3 names repeating until correct).

ATTENTION AND CALCULATION

Subtract 7 from 100, then repeat from result. Continue five times: 100, 93, 86, 79, 72. (Alternative: spell "WORLD" backwards: DLROW).

RECALL

Ask for the names of the three objects learned earlier.

LANGUAGE

Name two objects (e.g. pen, watch).

Repeat "No ifs, ands, or buts".

Give a three-stage command. Score 1 for each stage. (e.g. "Place index finger of right hand on your nose and then on your left ear").

Ask the patient to read and obey a written command on a piece of paper. The written instruction is: "Close your eyes".

Ask the patient to write a sentence. Score 1 if it is sensible and has a subject and a verb.

COPYING: Ask the patient to copy a pair of intersecting pentagons

TOTAL: _____/30

MMSE scoring

24-30: no cognitive impairment
 18-23: mild cognitive impairment
 0-17: severe cognitive impairment



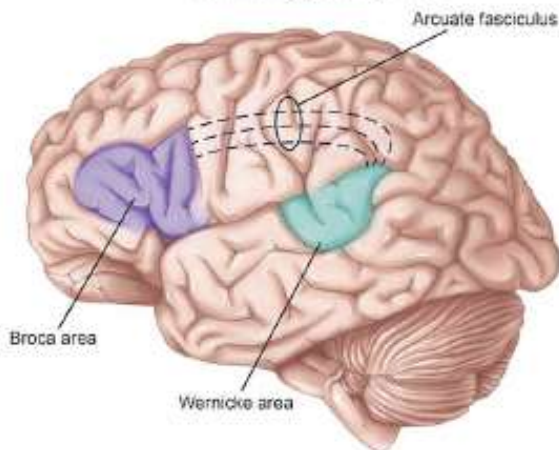
Types of aphasia

Aphasia: higher-order language deficit (inability to understand/speak/read/write)

* Compare with dysarthria, a motor inability to speak (movement deficit)

“Broca has a broken boca, Wernicke is wordy”

Common types of aphasia

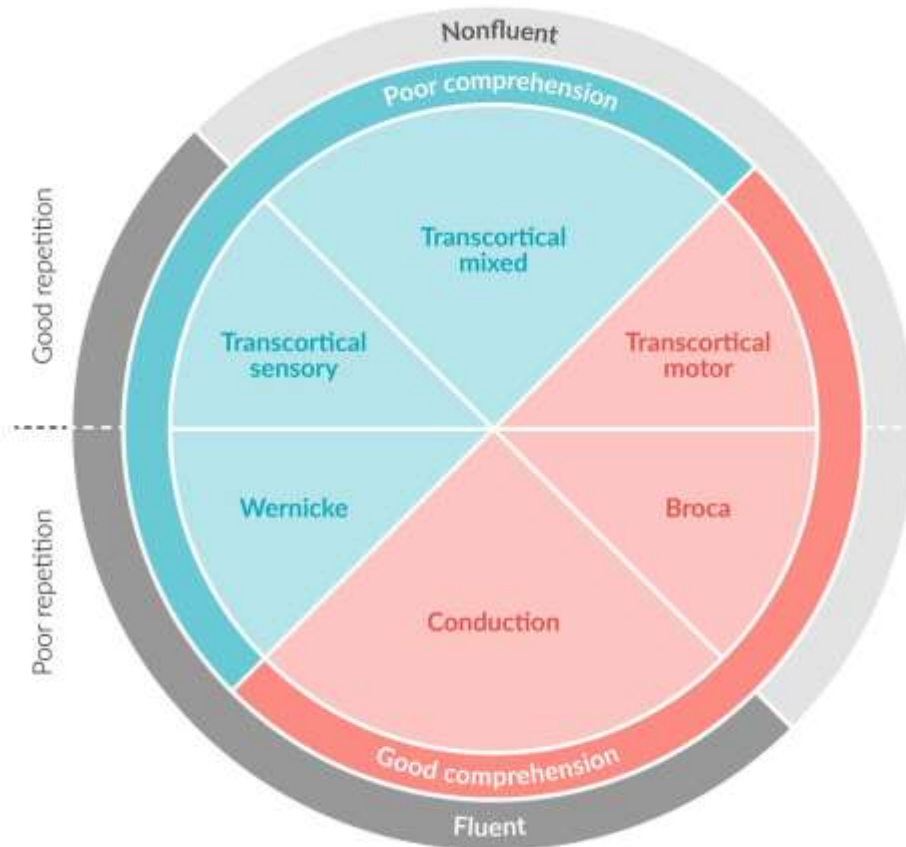


Aphasia syndrome	Spontaneous speech	Comprehension	Repetition	Associated features
Broca	Sparse & nonfluent	Relatively preserved	Impaired	Right hemiparesis (face & upper limb)
Wernicke	Fluent & voluminous but lacks meaning	Greatly diminished	Impaired	Right superior visual field defect
Conduction	Fluent with phonemic errors	Relatively preserved	Very poor	None



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Types of Aphasia





Cranial nerves



Cranial nerves

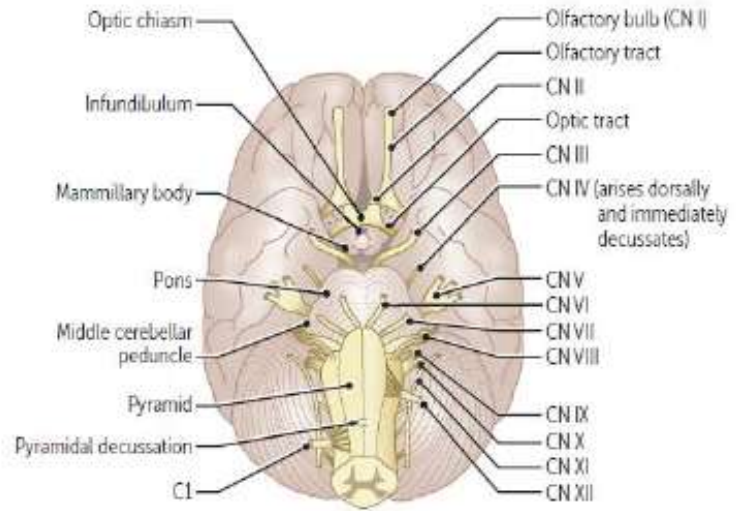
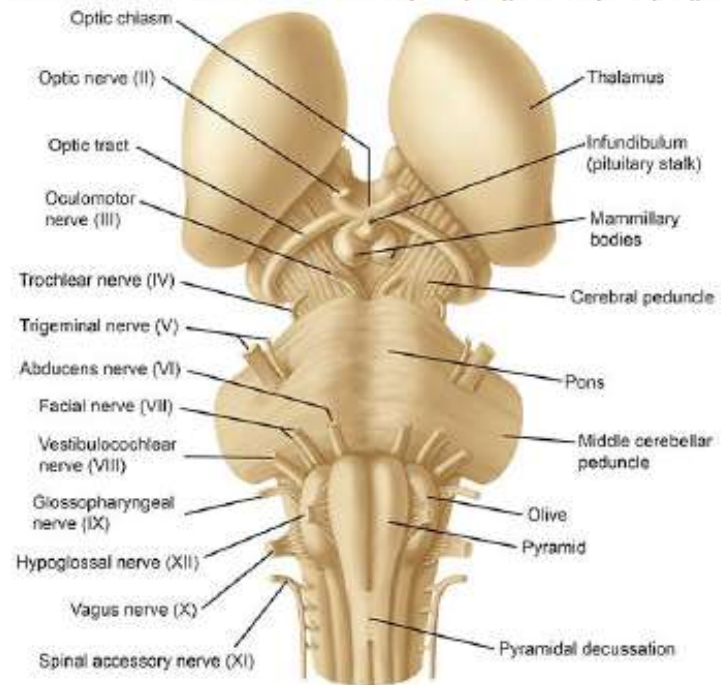
The bare minimum

Check the fundi, visual fields,
pupil size and reactivity,
extraocular movements and facial
movements



Cranial nerves

- Brain Stem – Ventral View – 4 CN above pons (1-4), 4 CN in pons (5-8), 4 CN in medulla (9-12), 4 CN nuclei are medial (3, 4, 6, 12, all primarily motor)





The cranial nerves

Cranial Nerve	CN	Function	Type
Olfactory	1	Smell (only CN without thalamic relay to cortex)	Sensory
Optic	2	Sight	Sensory
Oculomotor	3	Eye movement (SR, IR, MR, IO), pupillary constriction (sphincter pupillae via Edinger-Westphal nucleus, muscarinic receptors), accommodation, eyelid opening (levator palpebrae)	Motor
Trochlear	4	Eye movement (SO)	Motor
Trigeminal	5	Mastication, facial sensation (ophthalmic, maxillary, mandibular divisions), general sensation from anterior 2/3 of tongue	Both
Abducens	6	Eye movement (LR)	Motor
Facial	7	Facial movement, taste from anterior 2/3 of tongue, lacrimation, salivation (submandibular and sublingual glands), tight eyelid closing (orbicularis oculi), auditory volume modulation (stapedius)	Both
Vestibulocochlear	8	Hearing, balance	Sensory
Glossopharyngeal	9	Taste and general sensation from posterior 1/3 of tongue, swallowing, salivation (parotid gland), monitoring carotid body and sinus chemo- and baroreceptors, elevation of pharynx/larynx (stylopharyngeus)	Both
Vagus	10	Taste from supraglottic region, swallowing, soft palate elevation, midline uvula, talking, cough reflex, parasympathetics to thoracoabdominal viscera, monitoring aortic arch chemo- and baroreceptors	Both
Accessory	11	Head turning, shoulder shrugging (SCM, trapezius)	Motor
Hypoglossal	12	Tongue movement	Motor



Visual acuity - Visual fields

Test for visual acuity!

As a screening test, it is usually sufficient to examine the visual fields of both eyes simultaneously

Monocular visual loss

Ipsilateral retinal or optic nerve lesion

Retinal, e.g. central retinal artery/vein occlusion, retinal detachment**

Optic nerve, e.g. optic neuritis, optic atrophy, glaucoma**

Bitemporal hemianopia

Optic chiasm lesion

e.g. pituitary tumour, craniopharyngioma

Homonymous hemianopia

Contralateral optic tract (or whole optic radiation) lesion

*e.g. middle cerebral artery occlusion (stem)**

Homonymous inferior quadrantanopia

Contralateral parietal (upper) optic radiation lesion

*e.g. parietal tumour or middle cerebral artery occlusion (superior branch)**

Homonymous superior quadrantanopia

Contralateral temporal (lower) optic radiation lesion

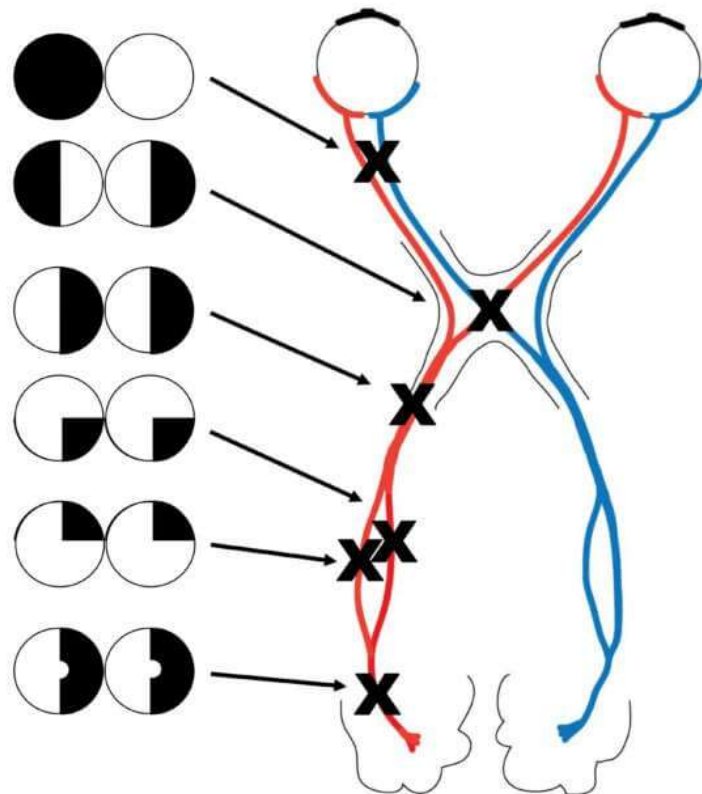
*e.g. temporal tumour or middle cerebral artery occlusion (inferior branch)**

Homonymous hemianopia with macular sparing

Contralateral occipital visual cortex lesion

*e.g. posterior cerebral artery occlusion**

PITS
Parietal
Inferior
Temporal
Superior



* = acute causes

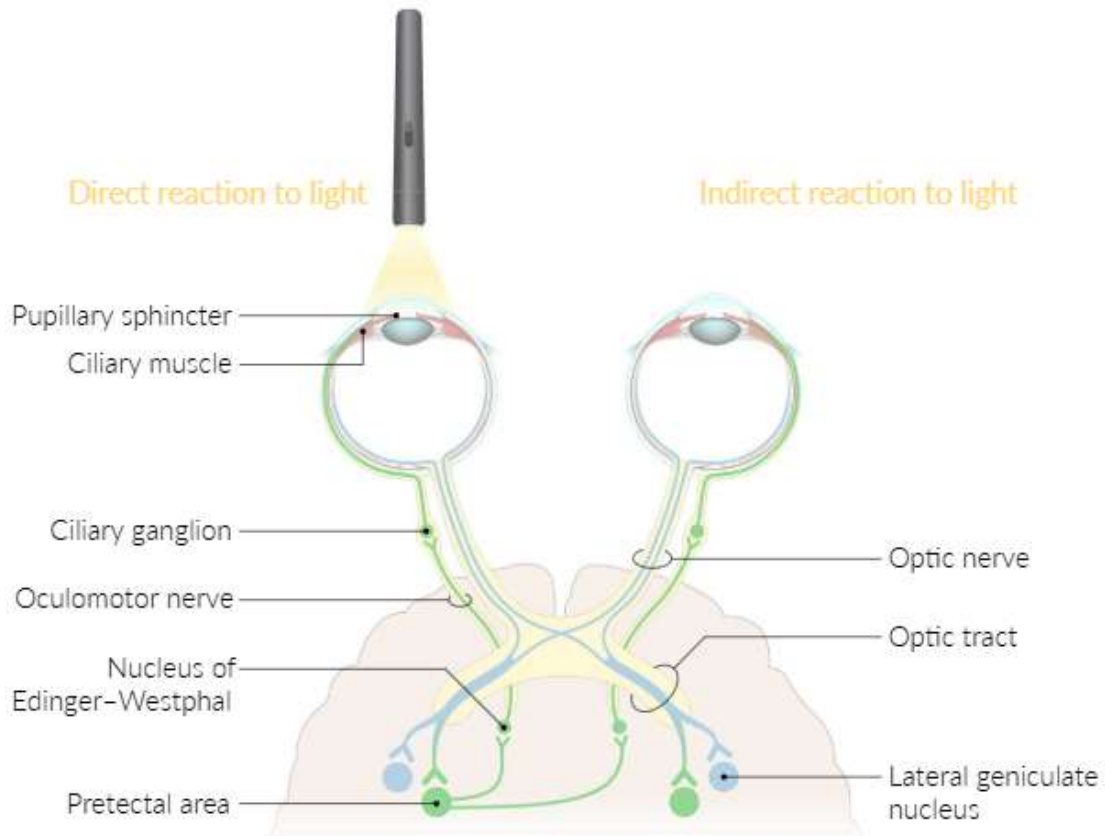


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Pupillary light reflex

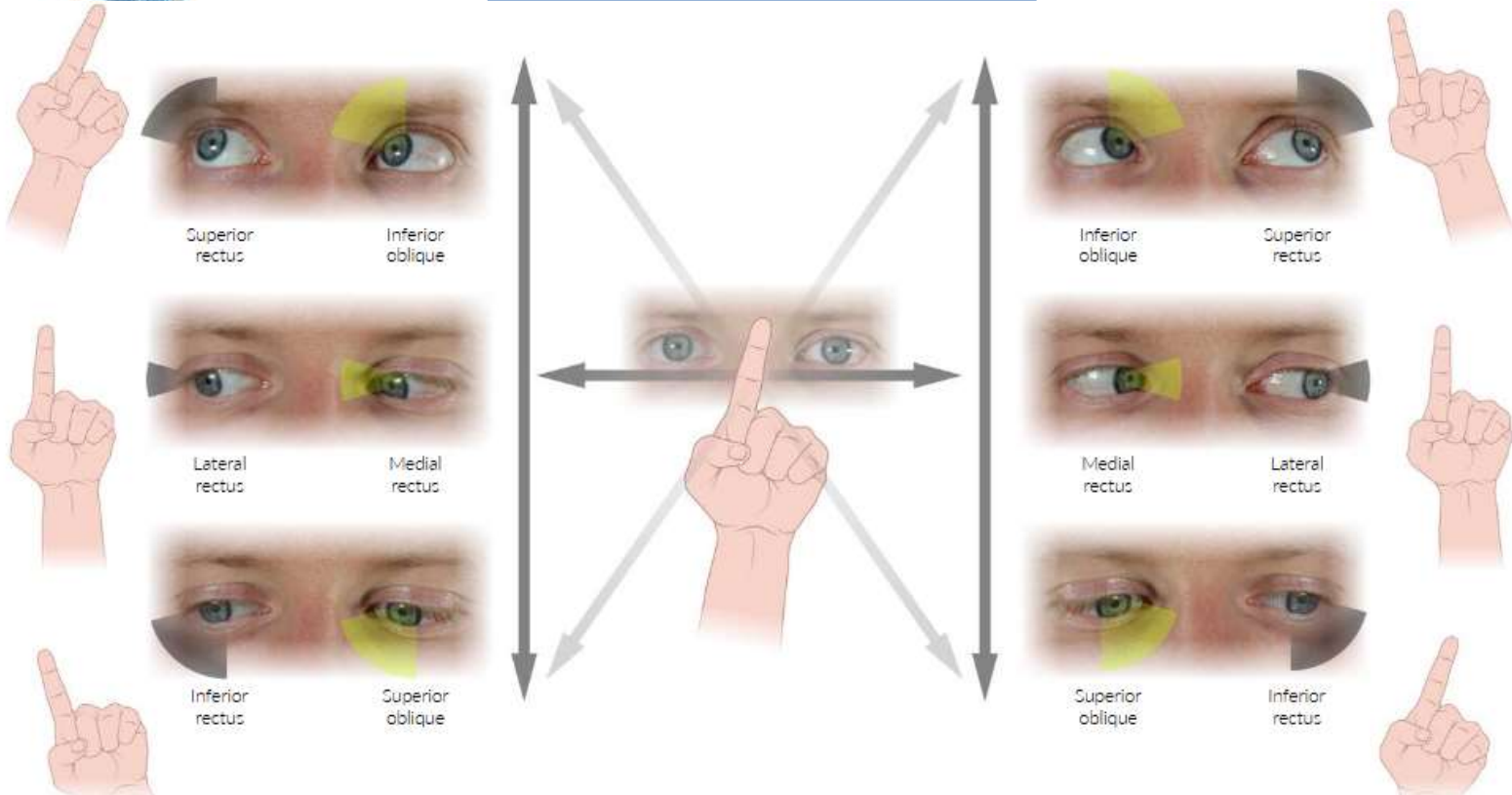




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Extra-ocular muscles



In clinical practice, typically more useful to determine whether the patient describes diplopia in any direction of gaze; true diplopia should almost always resolve with one eye closed



Cranial nerve III palsy "Blown pupil" - Down and out gaze



Patient trying to look straight ahead, affected (right) eye "down and out" with mydriasis



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Nystagmus

Best assessed at 45°, not at extreme lateral gaze (uncomfortable for the patient)

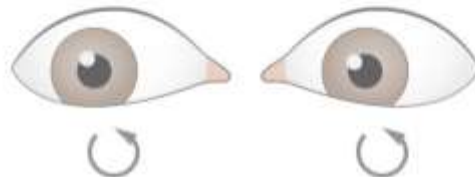
Horizontal nystagmus



Vertical nystagmus



Torsional (rotary) nystagmus

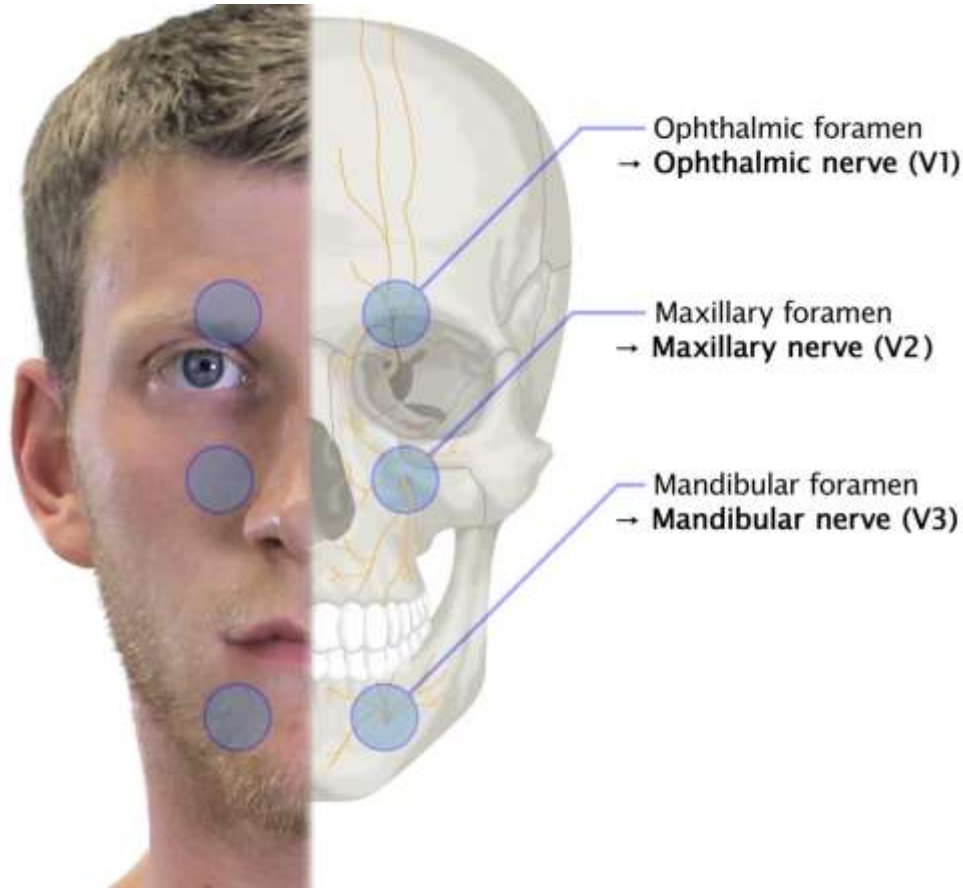




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Trigeminal Nerve



Two sensory modalities
(**light touch** and
temperature) usually
sufficient for screening

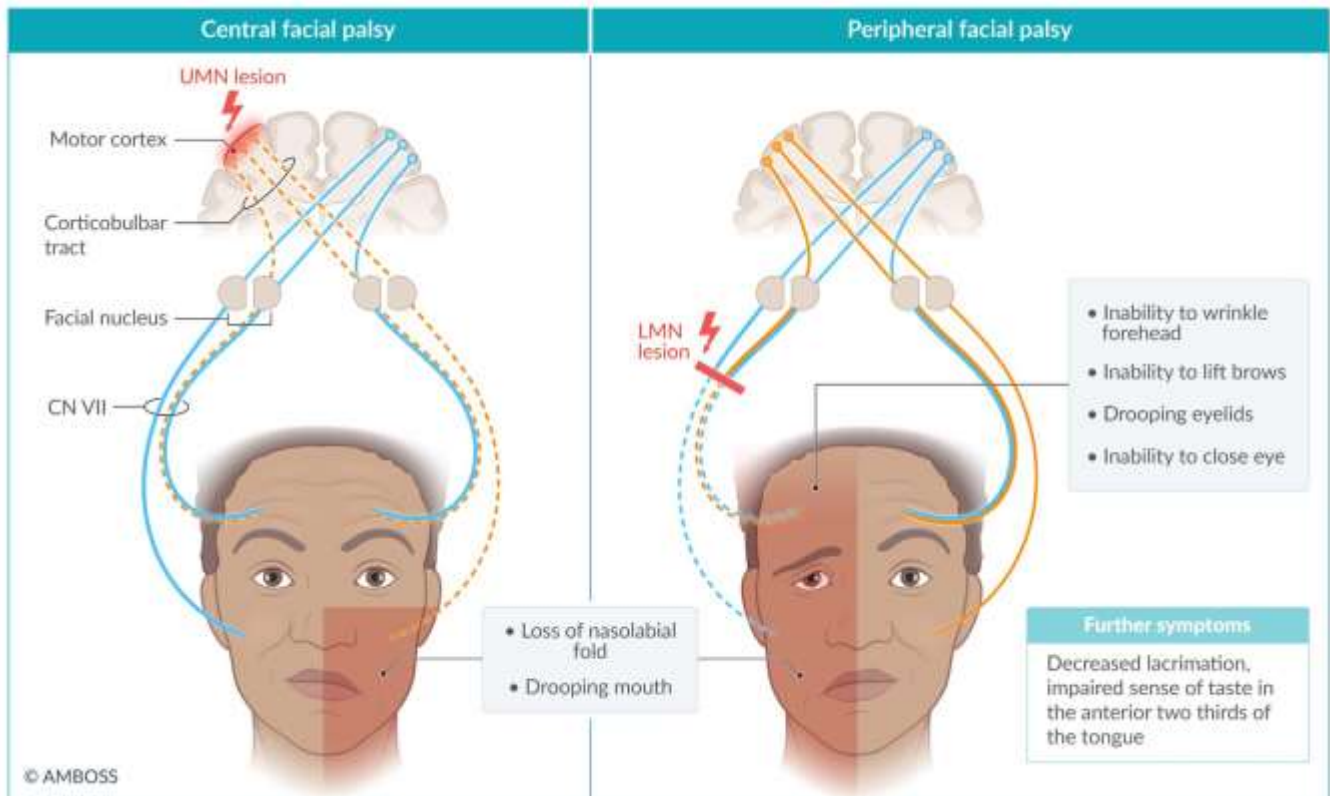
They derive from different
anatomic pathways



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CN VII: Check for face asymmetry at rest and with spontaneous movements

Facial Nerve Palsy





Facial nerve palsy

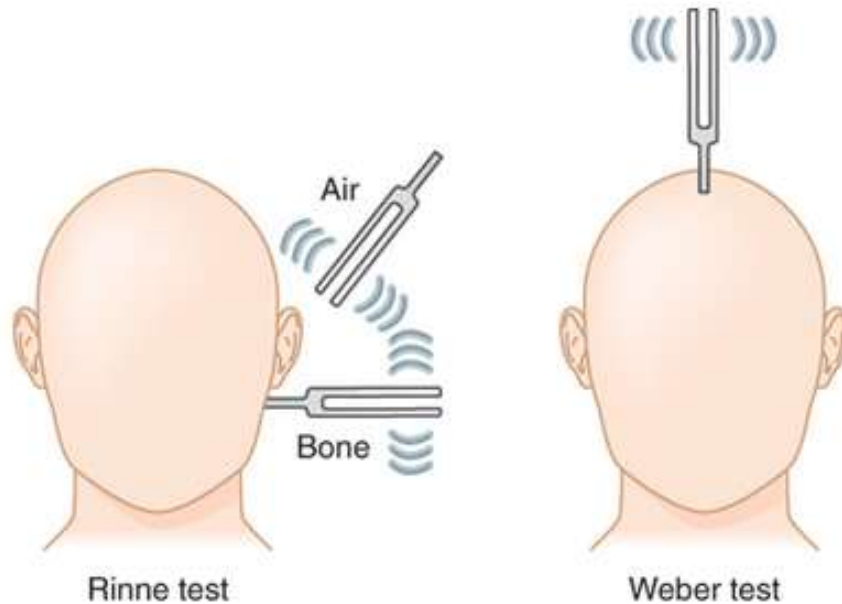


At left, a patient tries to smile as Bell's palsy affects the right side of his face (Source: James Heilman, MD). At right, the path of the facial nerve is shown on the right side of the face.



Hearing loss

Rinne and Weber tests



Hearing loss	Rinne test (Conduction)	Weber test (Localization)
None	Air > bone	Midline
Sensorineural	Air > bone	Normal ear
Conductive	Bone > air	Affected ear



Motor system/Muscle strength



Motor examination

The bare minimum

Look for muscle atrophy and check extremity tone. Assess upper extremity strength by checking for pronator drift and strength of wrist or finger extensors. Tap the biceps, patellar, and Achilles reflexes. Test for lower extremity strength by having the patient walk normally and



Motor examination

- Muscle appearance
 - Fasciculations, Tenderness, atrophy/hypertrophy, involuntary movements (eg Parkinson's)
- Muscle tone
 - Decreased tone most commonly due to lower motor neuron or peripheral nerve disorders
 - Increased tone: spasticity (corticospinal tract disease), rigidity (parkinsonism)
- Muscle strength
- Reflexes



Upper and lower motor neurons

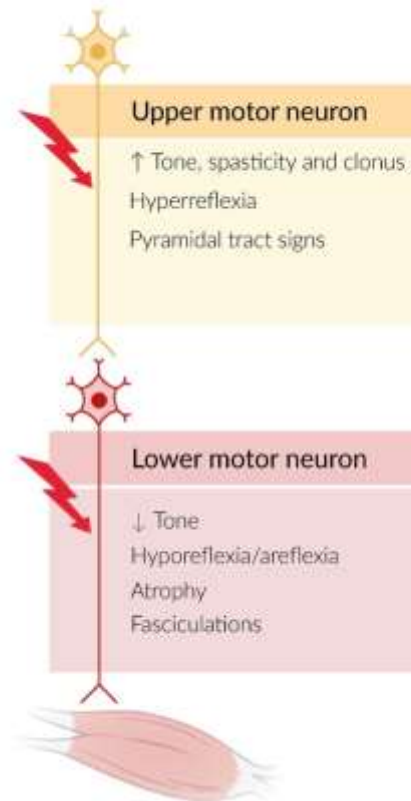
- Lower motor neuron (LMN) lesions result in everything lowered (less muscle mass, decreased muscle tone, diminished reflexes, downgoing toes)
- Upper motor neuron (UMN) lesions result in everything up (increased muscle tone, increased reflexes, upgoing toes)
- Positive Babinski sign is normal in infants (i.e. not indicative of a UMN lesion as it is in adults)

Sign	UMN Lesion	LMN Lesion
Weakness	+	+
Atrophy	–	+
Fasciculations	–	+
Reflexes	↑	↓
Tone	↑	↓
Babinski Reflex	+	–
Spastic Paresis	+	–
Flaccid Paralysis	–	+
Clasp Knife Spasticity	+	–



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Upper & Lower Motor Neuron





Medical Research Council of the United Kingdom scale for muscle strength

- 0: No visible muscle contraction
- 1: Visible muscle contraction with no or trace movement
- 2: Limb movement, but not against gravity
- 3: Movement against gravity but not resistance
- 4: Movement against at least some resistance supplied by the examiner
- 5: Full strength

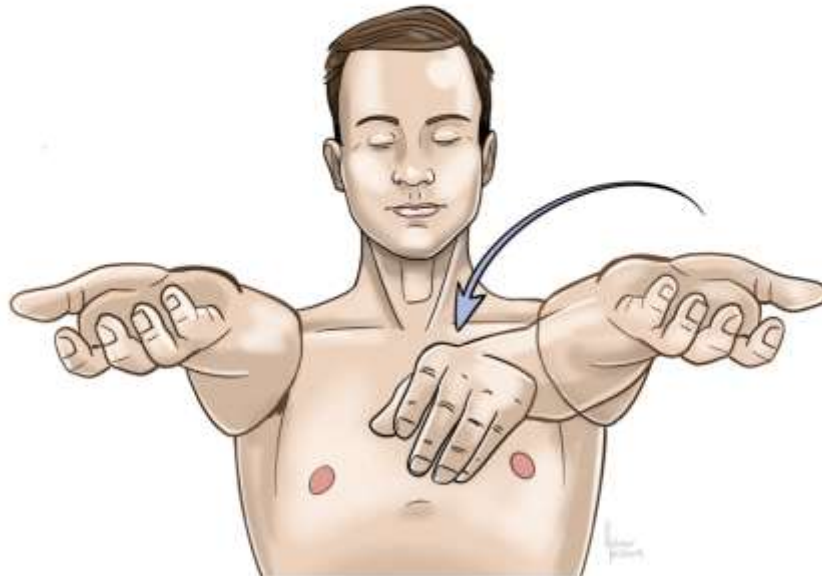


Pronator drift

Very useful for upper limb weakness!

Pronator drift

- 1st downward arm drift
- 2nd forearm pronation
- 3rd flexion of the wrist and elbow



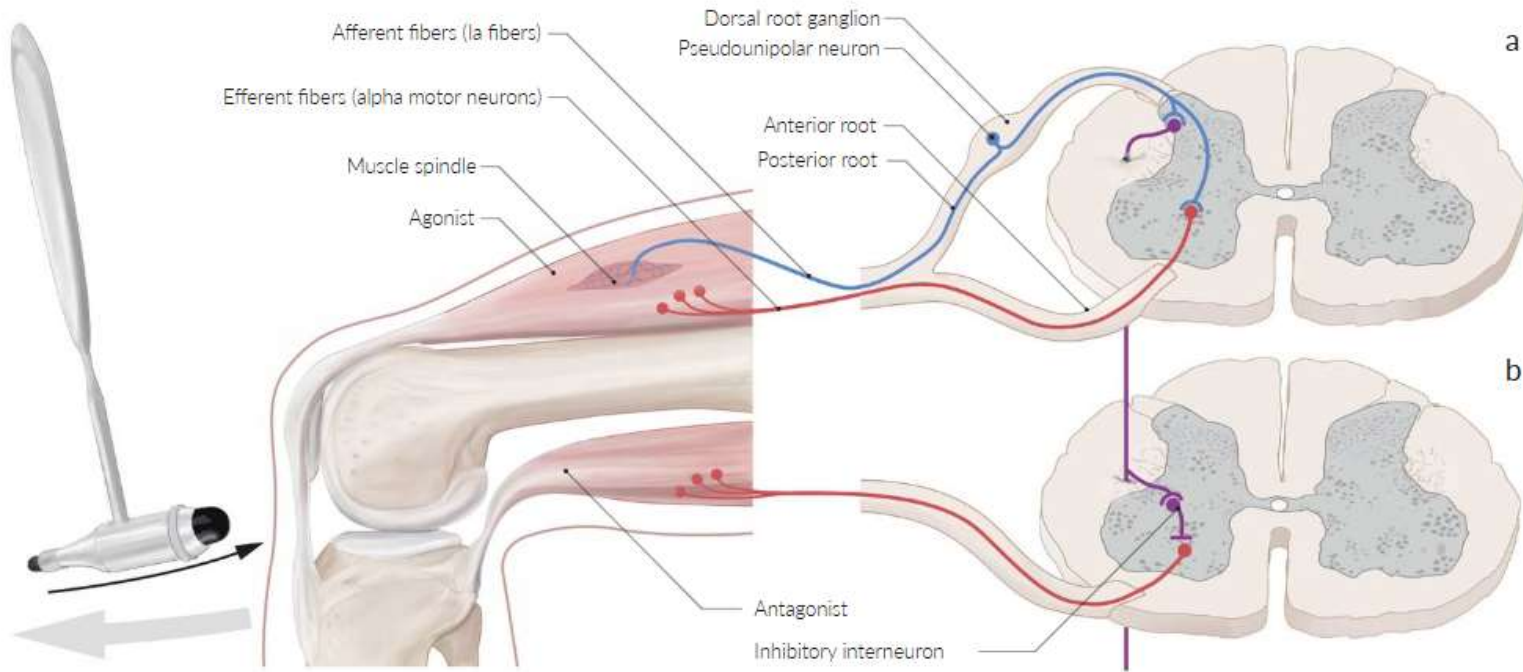


Reflexes



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Stretch Reflex





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Deep Tendon Reflexes

Reflexes tested include the following:

- Biceps (innervated by C5 and C6)
- Radial brachialis (by C6)
- Triceps (by C7)
- Distal finger flexors (by C8)
- Quadriceps knee jerk (by L4)
- Ankle jerk (by S1)
- Jaw jerk (by the 5th cranial nerve)

Reflex	Spinal level
	C5-6
	C7-8
	L2-4
	L5
	S1-2



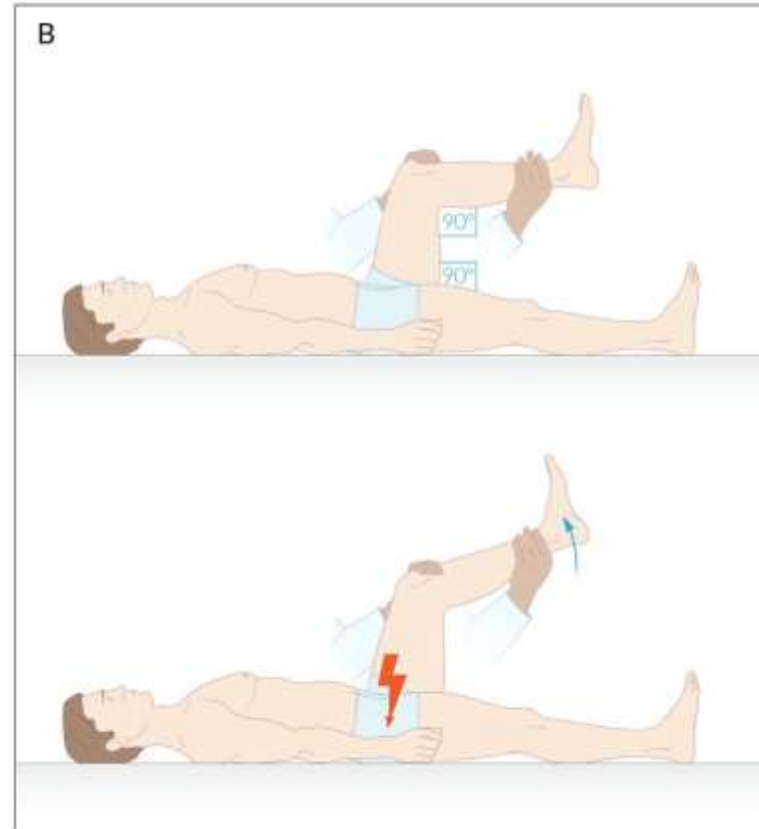
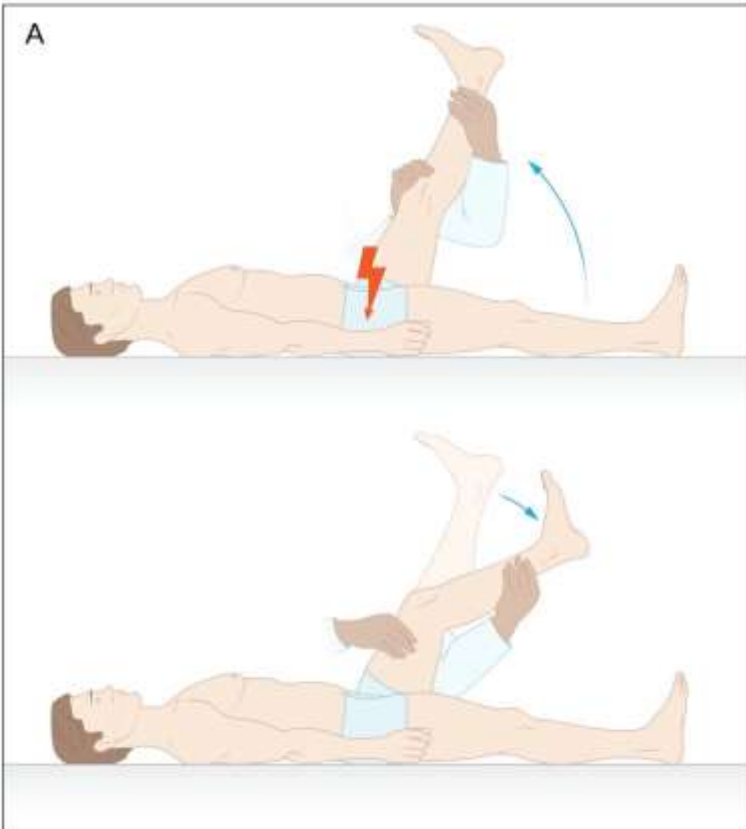
Reflexes Grading

- 0 = Absent
- 1 = Present but diminished
- 2 = Normoactive
- 3 = Exaggerated
- 4 = Clonus



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Kernig Sign

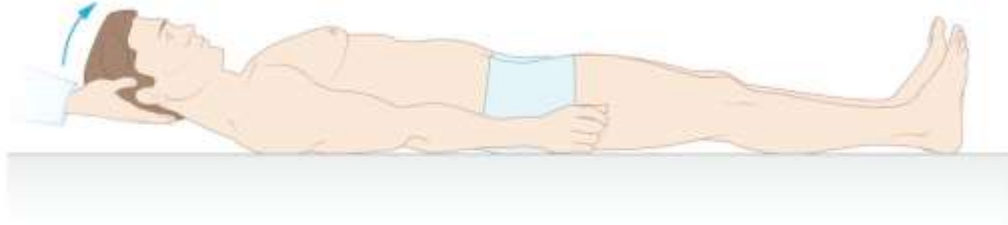




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Brudzinski Sign

A



B





Sensation



Sensory examination

The bare minimum

Ask whether the patient can feel light touch and the temperature of a cool object in each distal extremity. Check double simultaneous stimulation using light touch on the hands.

Usually the most unreliable part of the neuro exam: subjective and difficult to quantify



Primary sensory modalities

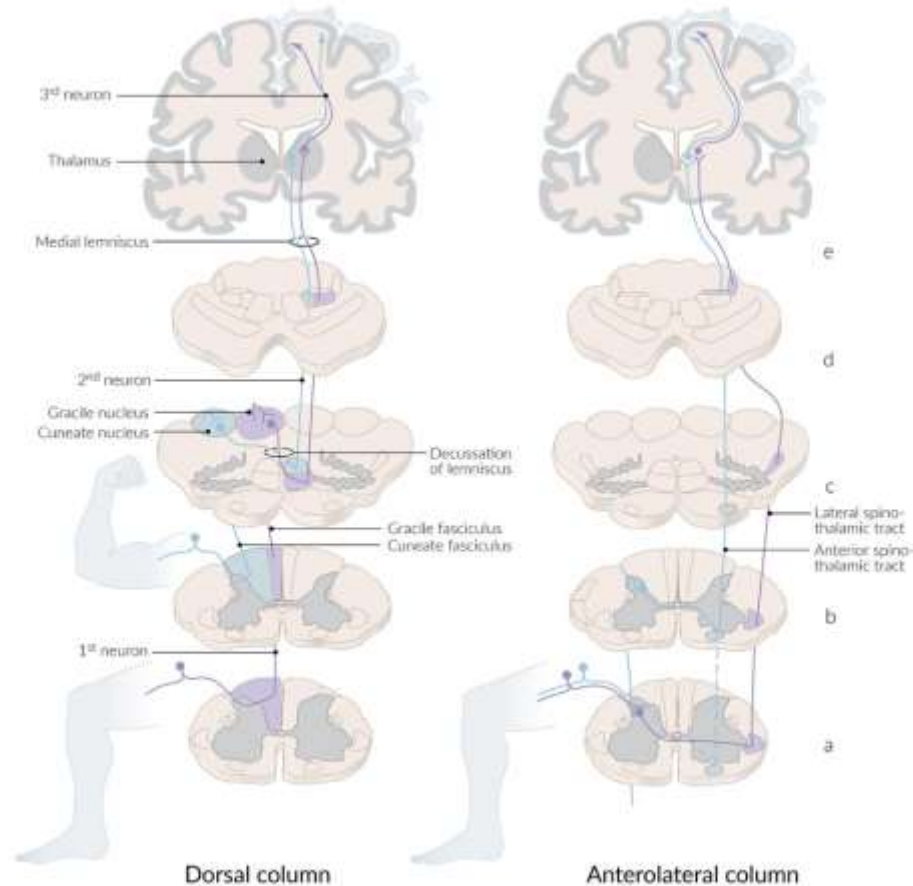
- Light touch
- Pain
- Temperature
- Vibration
- Joint position



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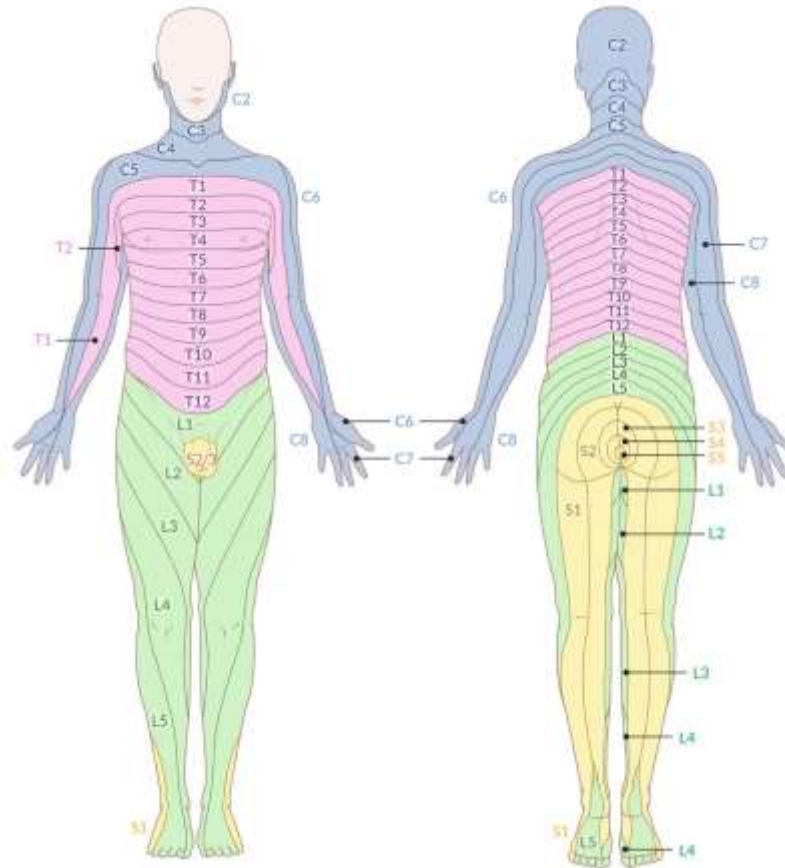
Sensory Tracts





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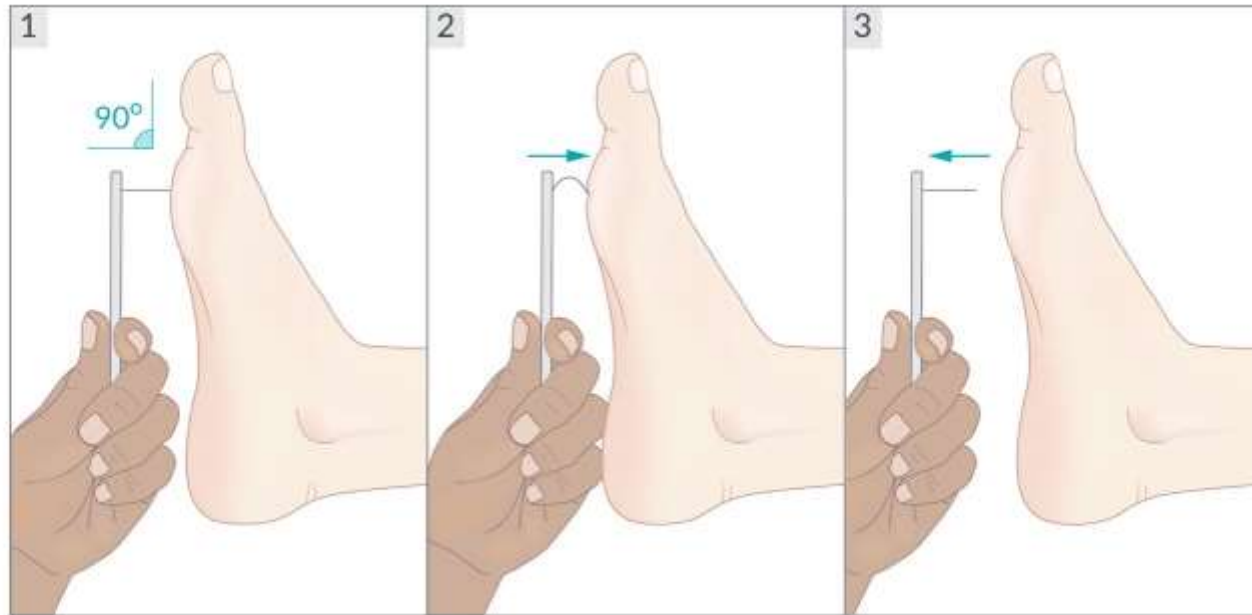
Dermatomes





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Monofilament test

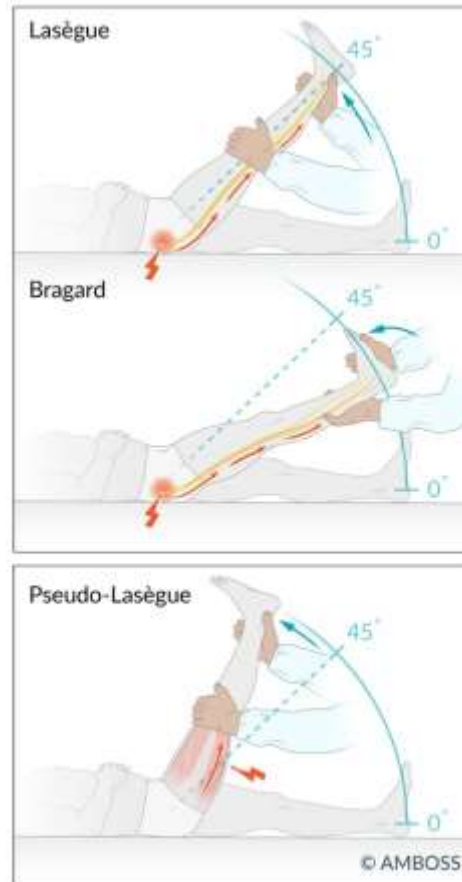




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Straight leg raise tests





Coordination examination

The bare minimum

Test rapid alternating movements of the hands and feet, and the finger-to-nose maneuver.



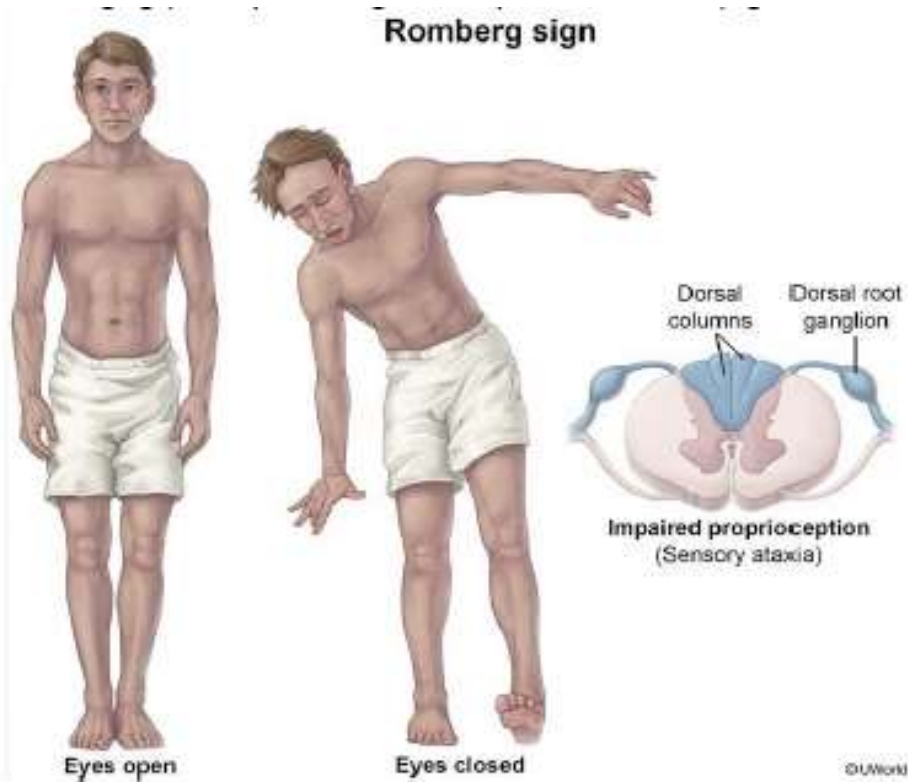
Signs of cerebellar disorders

Deficit	Manifestation
Ataxia	Reeling, wide-based gait
Decomposition of movement	Inability to correctly sequence fine, coordinated motor acts
Dysarthria	Inability to articulate words correctly, with slurring
Dysdiadochokinesia	Uncoordinated rapid alternating movements
Dysmetria	Impaired ability reach a target with goal-directed movement
Hypotonia	Decreased muscle tone
Nystagmus	Involuntary, rapid oscillation of the eyeballs in a horizontal, vertical, or rotary direction, with the fast component maximal toward the side of the cerebellar lesion
Scanning speech	Slow enunciation with a tendency to hesitate at the beginning of a word or syllable
<u>Tremor</u>	Rhythmic, alternating, oscillatory movement of a limb as it approaches a target (intention tremor) or of proximal musculature when fixed posture or weight bearing is attempted (postural tremor); characterized by high amplitude and low frequency



Romberg sign

- Eyes open: Cerebellar ataxia
- Eyes closed: lesion in posterior columns (e.g. Tabes Dorsalis, Vitamin B12 Deficiency) or peripheral nerves (e.g. Type 2 DM)





Gait examination

The bare minimum

Observe the patients while walking normally, on the heels and toes, and along a straight line.



Types of gait abnormalities

Hemiplegic



Parkinsonian



Neuropathic





Parkinsonian gait

Typical appearance of Parkinson disease





Take-home messages

- Neurologic examination: LOCATE THE LESION(S)
 - Anatomy first, pathophysiology second
- Mental status
 - Screening test: MoCa, MMSE
- Cranial nerves
 - CN II, CN IV, VII, III-IV/VI
- Motor strength
 - Pronator drift, reflexes
- Sensory
 - Reliable mainly in well communicating and compliant patient
- Coordination
 - Rapid alternating movements
- Gait
 - Various gait abnormalities