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FAKULTNÍ NEMOCNICE BRNO

NEUROLOGICKÁ KLINIKA LF MU a FN BRNO

BEDSIDE NEUROLOGICAL EXAMINATION: SENSORY SYSTEM, MENINGEAL SYNDROME

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SENSORY SYSTEM

SENSORY EXAMINATION

- evaluation of sensory deficits is ***MORE DIFFICULT*** than evaluation of motor deficits
  - the **subjective** nature of the examination;
  - **inconsistency** in the patient's responses is common;
  - **the types of sensory abnormalities may differ** greatly among patients;
  - patients may **not be aware** of any sensory deficit (vibration, proprioception…);
  - or **don´t describe** the problems using apropriate words (confuse hypoesthesia with weakness, impaired proprioception causing the instability when walkig may describe as „vertigo“…).

- still represents ***INTEGRAL PART OF NEUROLOGICAL EXAMINATION***!
- It´s important **for localization** of the lesion (together with the presence/absence of motor deficits)
- the sensory data are always **considered in association with evidence of other neurological dysfunction**!!!
- If the findings are in correlation with the other parts of neurological examination and are anatomically reasonable and consistent, they are **considered as being „objective**“.

BASIC ANATOMY – RECEPTORS

- Sensory receptor = the part of sensory system **which responds to a stimulus** in the internal or external environment of an organism.
- **specialized for receiving specific kinds of stimuli** (mechanical, thermal, chemical…).
- **transduce the sensory signal to an electrical signal** in related sensory neuron
- **CLASSIFICATION BY LOCATION**:
  - **Exteroceptors** occur at or near the surface of the skin and are sensitive to stimuli occurring outside or on the surface of the body. These receptors include those for *tactile sensations, such as touch, pain, and temperature, as well as those for vision, hearing, smell, and taste.*
  - **Interoceptors** (visceroceptors) respond to stimuli occurring in the body from visceral organs and blood vessels, = the sensory neurons associated with *the autonomic nervous system*.
  - **Proprioceptors** respond to stimuli occurring in skeletal muscles, tendons, ligaments, and joints. These receptors collect mainly the information concerning *body position and movement.*

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BASIC ANATOMY – RECEPTORS

- **CLASSIFICATION BY TYPE OF STIMULUS DETECTED:**
  - **Mechanoreceptors** respond to physical force such as pressure (touch or blood pressure) and stretch.
  - **Thermoreceptors** respond to temperature changes.
  - **Nociceptors** respond to a variety of stimuli associated with tissue damage. The brain interprets the signal as the pain.
  - **Photoreceptors** respond to light.
  - **Chemoreceptors** respond to dissolved chemicals during sensations of taste and smell and to changes in internal body chemistry such as variations of O_2, CO_2, or H^+ in the blood.

SENSORY RECEPTORS (SKIN, JOINTS, MUSCLES)

RECEPTOR	TYPE	AFFERENT AXON	MODALITY
Muscle spindles	Specialized organ involving intrafusal muscle fibers and the associated nerves	Large-diameter myelinated axons	Muscle length and contraction
Golgi tendon organ	Specialized organs in the tendons near joints	Large-diameter myelinated axons	Joint position and rate of movement
Pacinian corpuscle	Multilayered capsule around a nerve terminal, producing a rapidly adapting mechanoreceptor	Large-diameter myelinated axons	Touch and vibration
Merkel's disk	Slowly adapting mechanoreceptor	Myelinated axons	Touch
Meissner's corpuscle	Specialized quickly adapting mechanoreceptor	Myelinated axons	Touch
Krause's end bulbs	Specialized terminal axon ending	Small myelinated axons	Thermal sensation
Free nerve ending	Branched terminal endings of axons	Small myelinated and unmyelinated axons	Strong tactile and thermal stimuli, especially painful inputs

According to : Misulis KE. CHAPTER 30 – Sensory Abnormalities of the Limbs, Trunk, and Face. In Bradley WG, Daroff RB, Fenichel GM, Jankovic J. Neurology in Clinical Practice, 5th ed. London: Elsevier 2008.

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SENSORY RECEPTORS AND AFFERENTS

- → **particular receptor is** related to **particular nerve fiber type**
- In general, **NOCICEPTIVE** afferents are **small myelinated and unmyelinated axons**.
- **NON-NOCICEPTIVE** afferents are **large-diameter myelinated axons**.

CLASS (OLDER TERMINOLOGY)	DIAMETER	CONDUCTION VELOCITY	MODALITIES
Ia (Aα) (myelinated)	12-20 μm	70-100 m/sec	Proprioception (muscle spindles)
Ib (Aα) (myelinated)	12-20 μm	70-100 m/sec	Proprioception (Golgi tendon organs)
II (Aβ) (myelinated)	5-12 μm	30-70 m/sec	Touch and pressure from skin; proprioception from muscle spindles
III (Aδ) (myelinated)	2-5 μm	10-30 m/sec	Pain and temperature; sharp sensation; joint and muscle pain sensation
IV (C, unmyelinated)	0.5-2.0 μm	0.5-2.0 m/sec	Pain, temperature

No need to know it in detail (just to get some idea about the principles ☺). The same applies to the previous table.

According to : Misulis KE. CHAPTER 30 – Sensory Abnormalities of the Limbs, Trunk, and Face. In Bradley WG, Daroff RB, Fenichel GM, Jankovic J. Neurology in Clinical Practice, 5th ed. London: Elsevier 2008.

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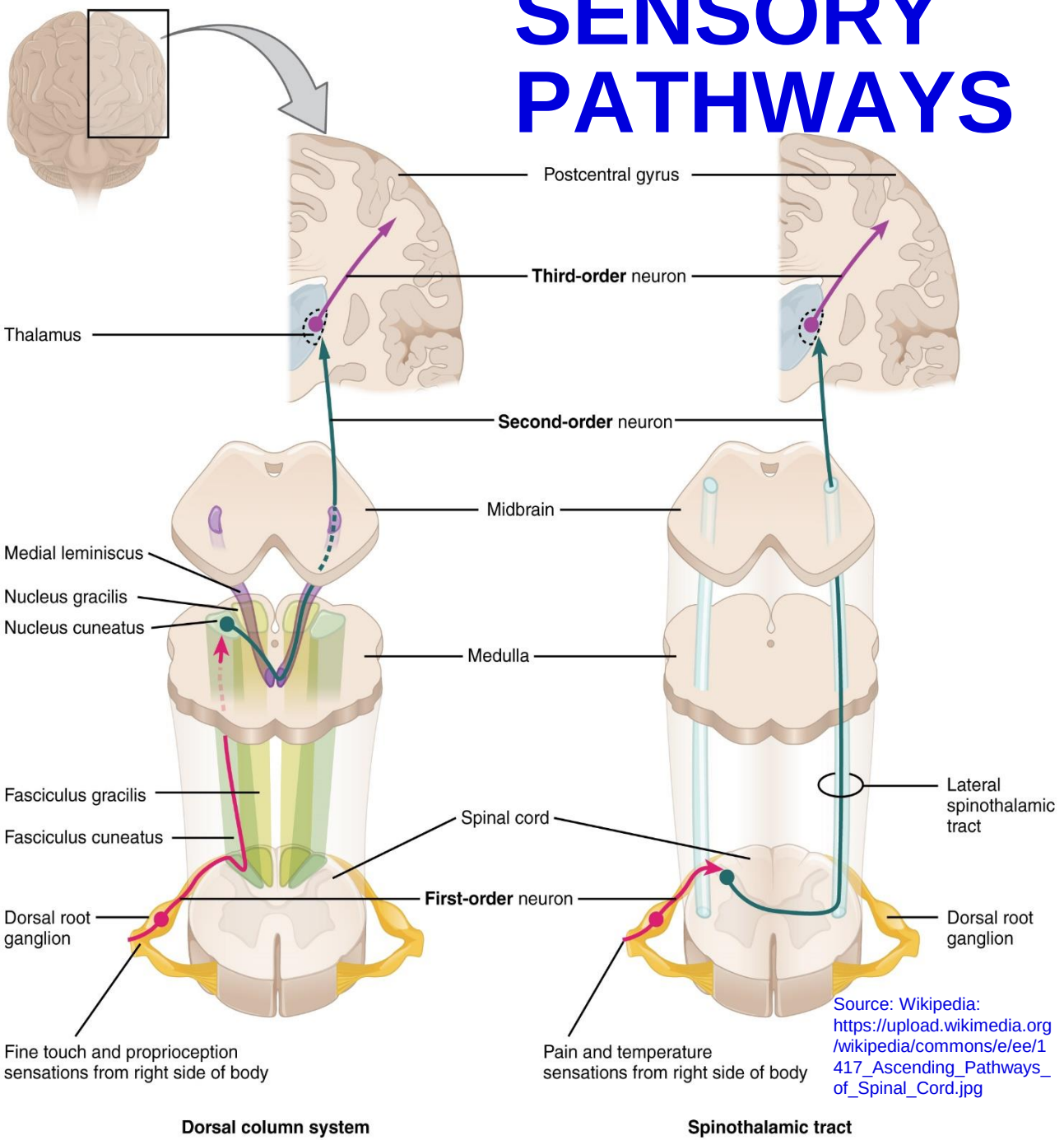
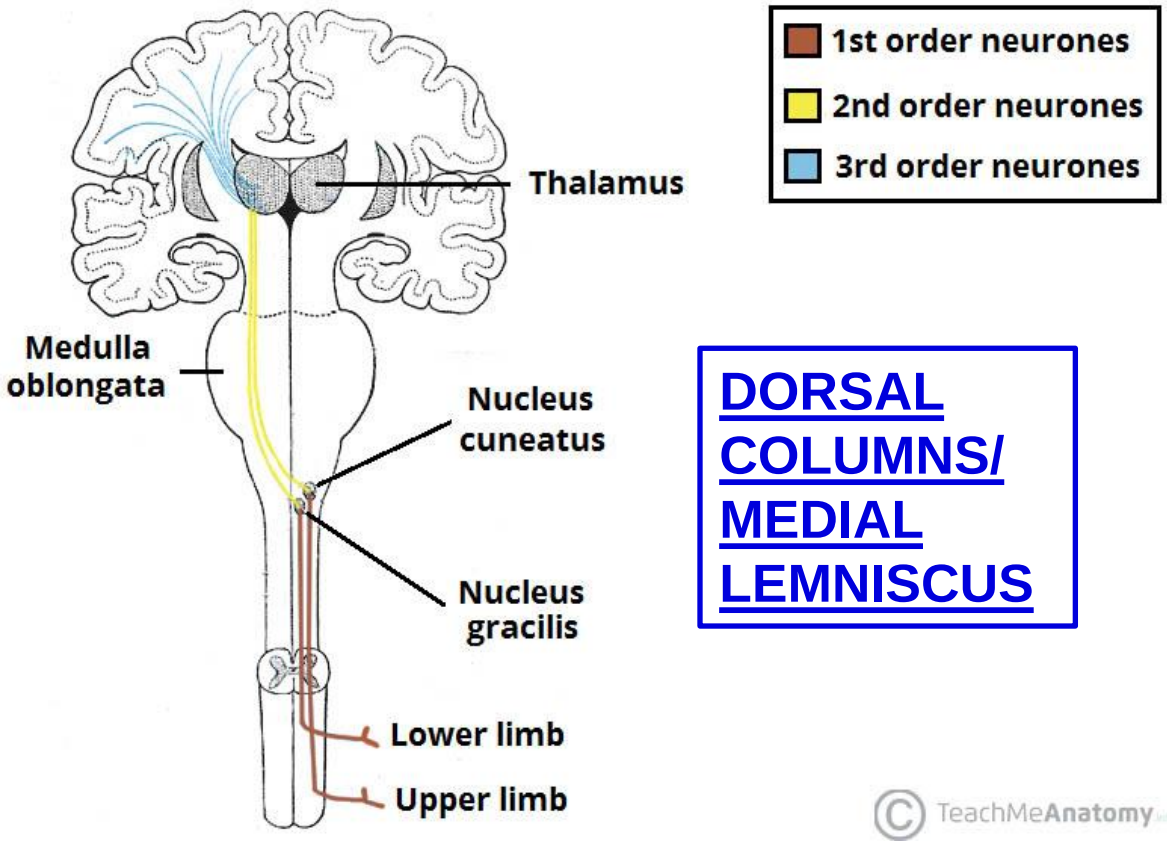
SENSORY PATHWAYS

- Sensory afferents pass through the **dorsal root ganglia** (1st sensory neurons)
- The contiue on to the **dorsal horn** of the spinal cord
- The give rise to **two major ascending pathways**:
  - The ***POSTERIOR COLUMNS*** (serving large-fiber modalities, i.e. discriminative touch, vibration, and proprioception)
  - these axons pass through the dorsal horn without synapsing and ascend in the **ipsilateral dorsal columns to** the cervicomedullary junction, where axons from the leg **synapse** in the nucleus gracilis (and from the arms in the nucleus cuneatus) and the second-order sensory neurons cross and ascend in the contralateral **medial lemniscus**
  - The ***ANTEROLATERAL SYSTEM*** (serving small-fiber modalities primarily, i.e. thermal sensation + nociception + affective touch)
  - These axons **synapse** in the dorsal horns, and the second-order sensory neurons cross in the anterior white commissure of the spinal cord to ascend in the **contralateral spinothalamic tract**.

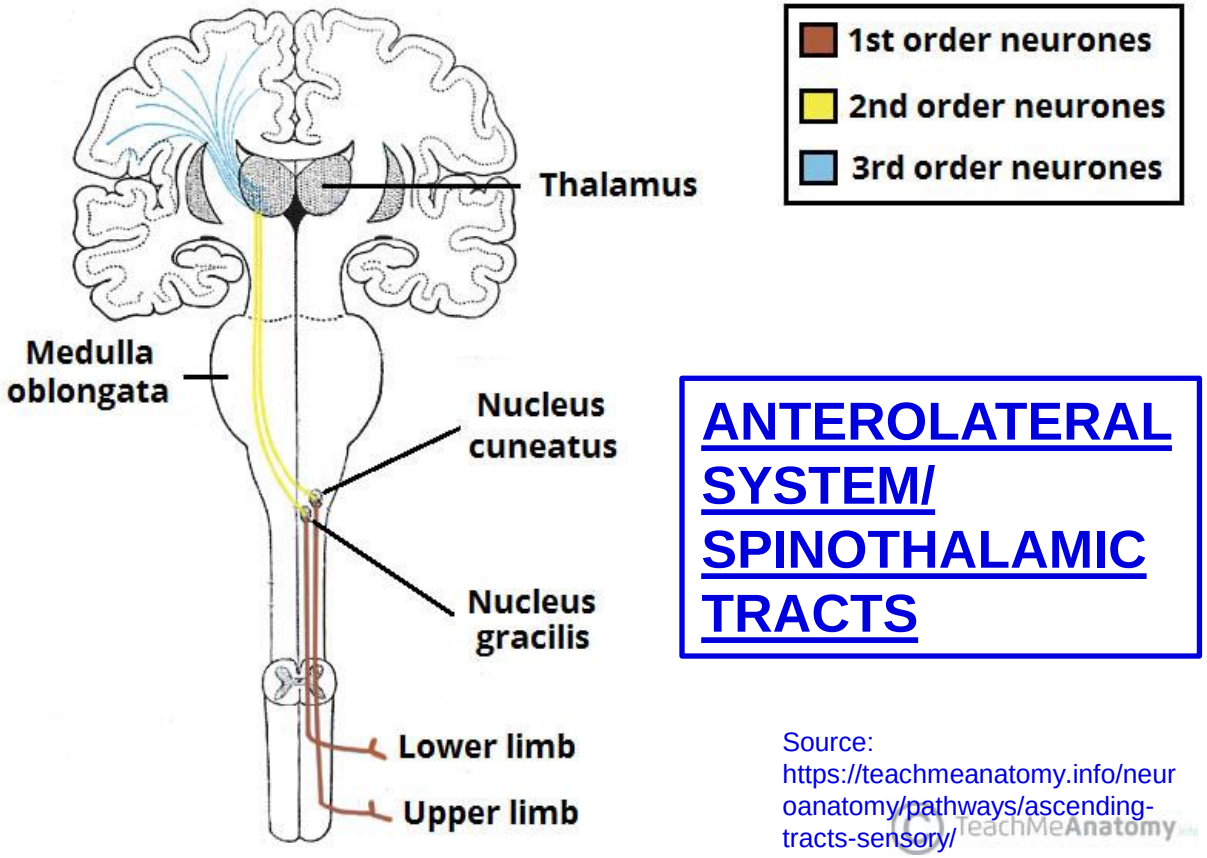


Source: Wikipedia: https://upload.wikimedia.org/wikipedia/commons/e/ee/1417_Ascending_Pathways_of_Spinal_Cord.jpg

SENSORY PATHWAY



DORSAL COLUMNS/ MEDIAL LEMNISCUS



ANTEROLATERAL SYSTEM/ SPINOTHALAMIC TRACTS

Source: https://teachmeanatomy.info/neuroanatomy/pathways/ascending-tracts-sensory/

→→→ Each the pathway consists from **3 sensory neurons connected in series**

1st in the dorsal root ganglia

2nd in the ipsilateral dorsal horn (anterolateral system)

or ipsilateral nucleus gracilis/cuneatus (DCLM system)

3rd in thalamus with cortical projection into the postcentral gyrus

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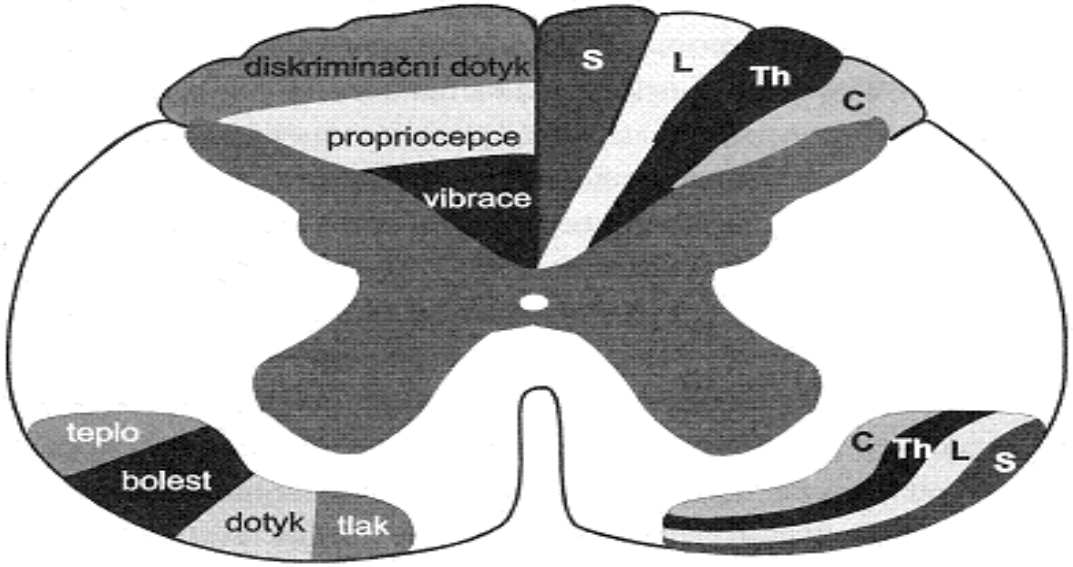
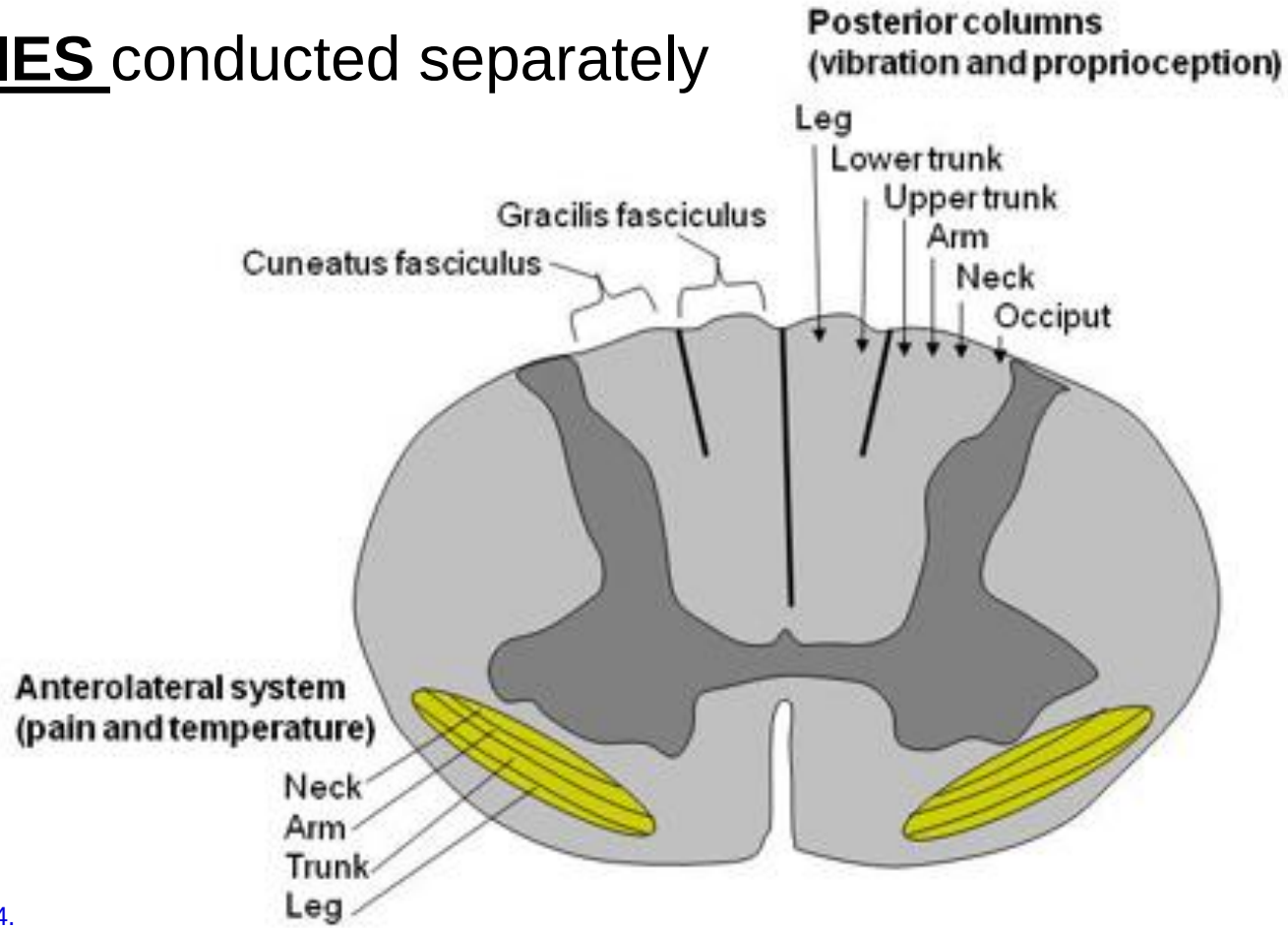
SPINAL SENSORY PATHWAY

- **SOMATOTOPIC ORGANISATION** of both pathway
- **DIFFERENT SENSORY MODALITIES** conducted separately



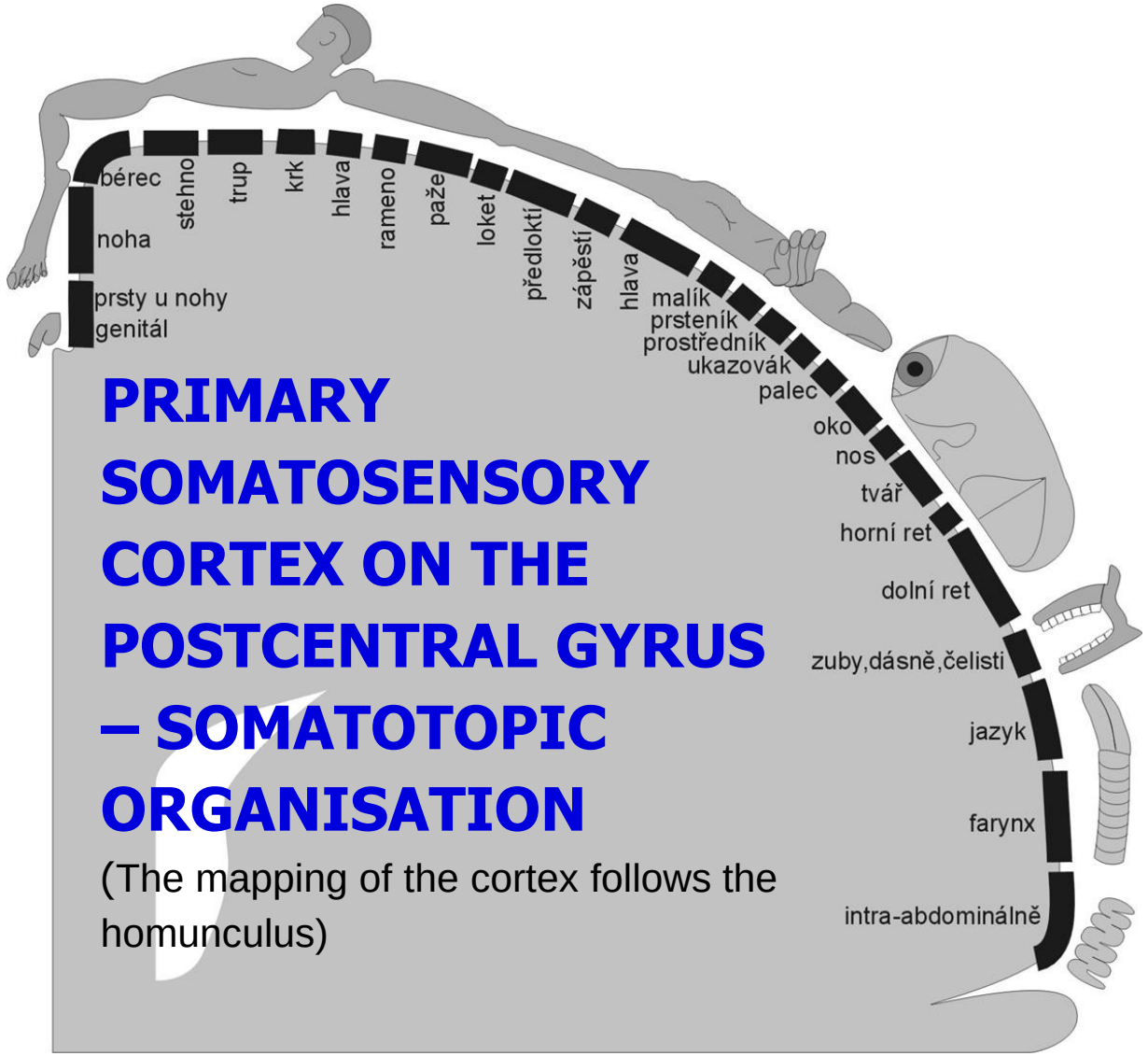


Source: Ambler Z, Bednařík J, Růžička E. Clinical Neurology – General Part. Praha: Triton 2004.
https://accessphysiotherapy.mhmedical.com/data/Multimedia/grandRounds/somatosensorypathways/media/somatosensorypathways_print.html

THALAMOCORTICAL PART OF THE PATHWAY

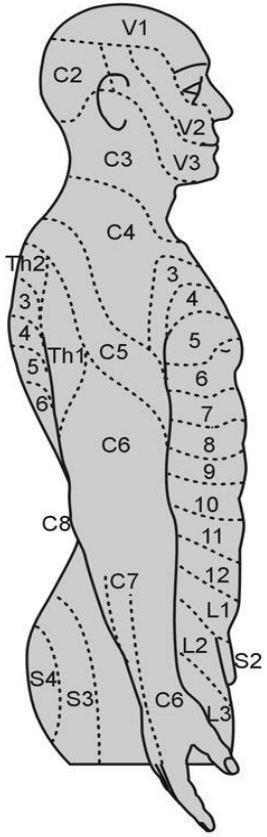
- In the **THALAMUS**: the **ventroposterior complex** is the ***main somesthetic receiving area*** and includes the *ventroposterior lateral nucleus*, which receives information from the body, and the *ventroposterior medial nucleus*, which receives sensory input from the head and face.
  - Projections are **to the primary somatosensory cortex on the postcentral gyrus.**

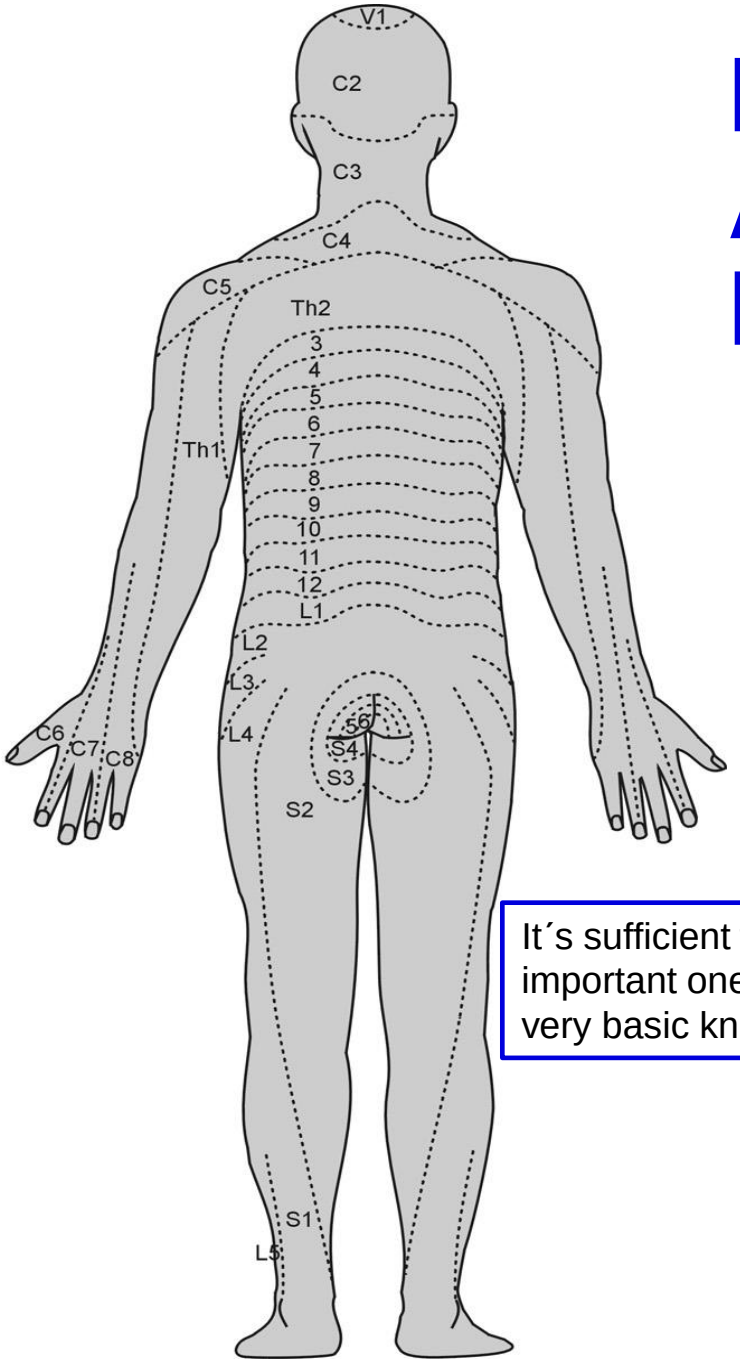
- **The posterior nuclear group** receives ***nociceptive input*** from the spinothalamic tract and projects mainly to the **secondary somesthetic region on the inner aspect of the postcentral gyrus**, adjacent to the insula.

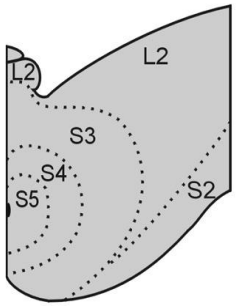


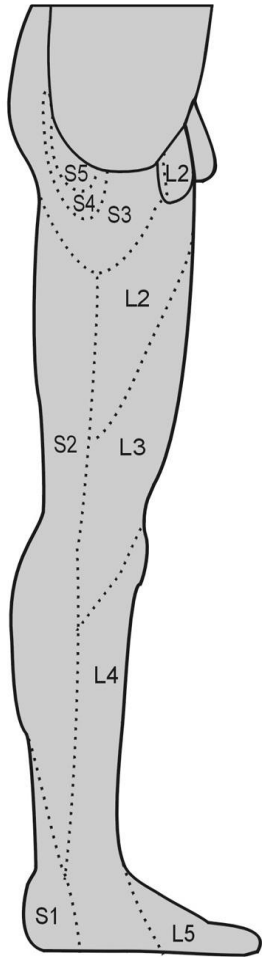
BASIC ANATOMY: DERMATOMES

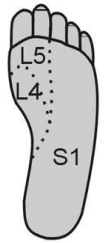
- ✓ 8 cervical,
- ✓ 12 thoracic,
- ✓ 5 lumbar,
- ✓ 5 sacral, and
- ✓ 1 coccygeal spinal nerves.









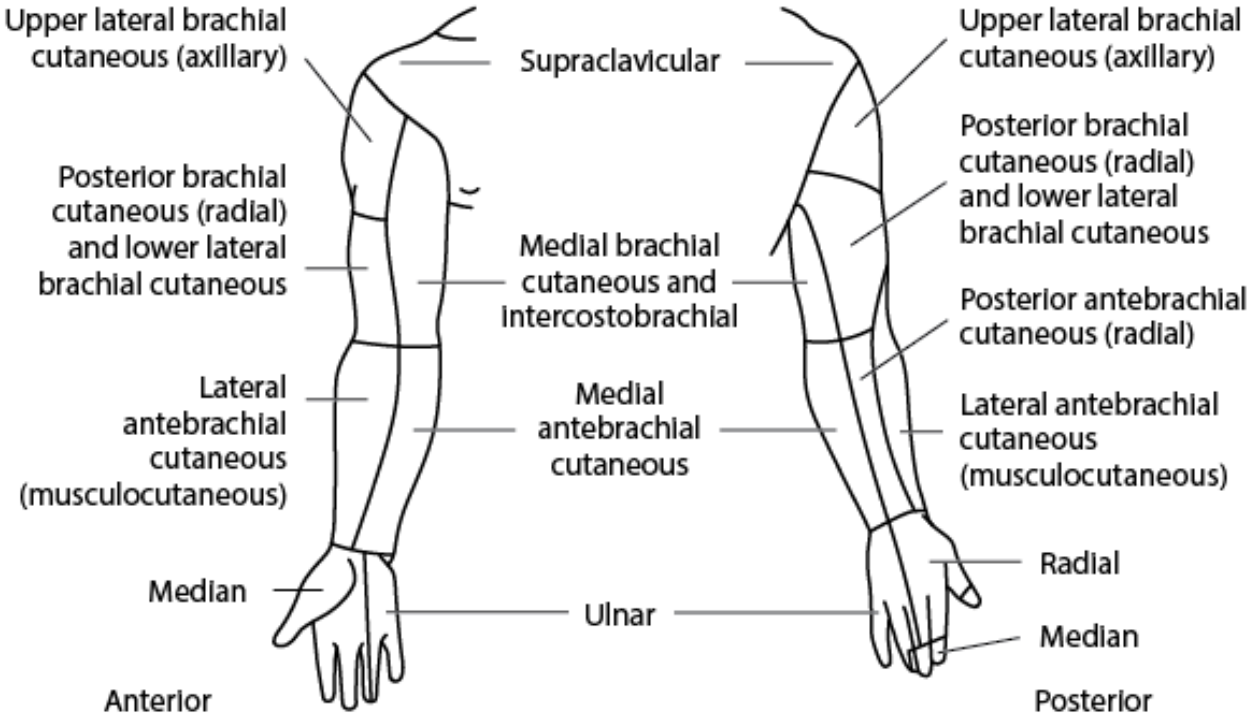


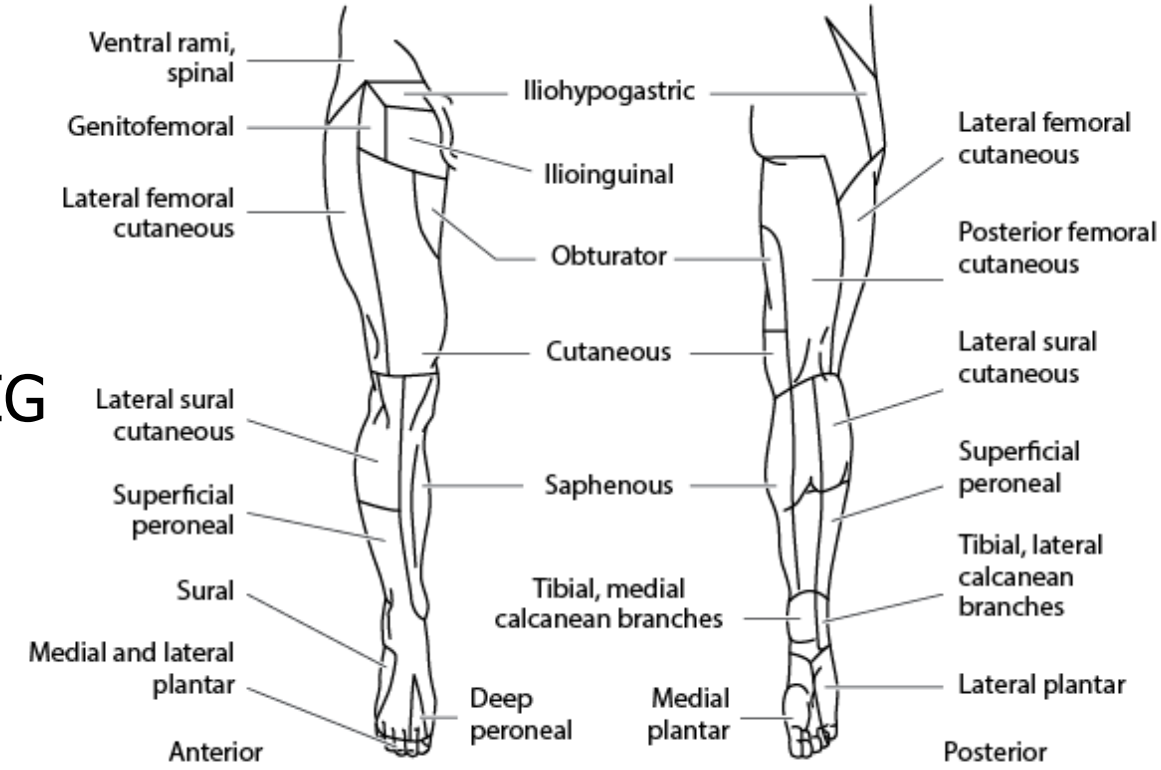
A DERMATOME is an area of skin that is mainly supplied by afferent nerve fibers from a **single dorsal root of spinal nerve/ single spinal segment.**

It´s sufficient to know the most important ones (C5-8 and L2-S2) + the very basic knowledge of the others ☺.

BASIC ANATOMY: CUTANEOUS FIELDS OF PERIHPERAL NERVES

NERVE SUPPLY OF THE HUMAN ARM AND LEG





No need to know it in detail (just to get some idea about the principles ☺)

Pictures taken from:
https://www.msdmanuals.com/professional/neurologic-disorders/neurologic-examination/how-to-assess-sensation

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SENSORY ABNORMITIES

- Sensory perception abnormalities are varied.
- The pattern of symptoms often is a clue to diagnosis. The most important **PATTERNS:**

- Loss of tactile sensation (***numbness***)
- ***Sensory ataxia***

NEGATIVE SYMPTOMS (relatively late)

- ***Neuropathic pain***
- ***Dysesthesia and paresthesia***

POSITIVE SYMPTOMS (usually earlier)

PARTICULAR PATTERNS MIGHT BE MIXED OR SEPARATE

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SENSORY SYMPTOMS - NUMBNESS

- **NUMBNESS IS THE LOSS OF SENSATION,** usually manifested as decreased sensory discrimination and elevated sensory threshold;
- It´s a **negative symptom**
- Numbness **may involve the 3 major sensory modalities to the same or different degrees:**
  (1) Light touch (2) Pain and temperature sensation (3) Position and vibration sensation

- !!! Patients often use the term *numbness* to mean a variety of other symptoms: weakness (and vice versa); positive sensory symptoms, such as dysesthesia and paresthesia.

- **OTHER TEMS used to describe decreased sensory perception:**
- **HYPESTHESIA** = a partial loss of sensitivity to the stimuli of a certain sensory modality (↑↑↑)
- **ANESTHESIA** = failure to perceive any sensory stimulus of a certain sensory modality (↑↑↑)

SYMPTOMS – SENSORY ATAXIA

- **SENSORY ATAXIA** is **the difficulty in coordination of a limb** that **results from loss of sensory input**, particularly **proprioceptive** input.
- is distinguished from cerebellar ataxia by the presence of near-normal coordination when the movement is visually observed by the patient, but **marked worsening** of coordination when the **eyes are shut.**

- Patients ***complain of*** **loss of balance in the dark**, typically when closing their eyes in the shower or removing clothing over the head.
- Objectivelly, patients with sensory ataxia ***demonstrate:***
  - **pseudoathetosis** (abnormal writhing movements, usually of the fingers, caused by a failure of the proprioception).
  - **positive Romberg´s sign** (with rapid worsening when the eyes are shut)

SYMPTOMS – DYSESTHESIA, PARESTHESIA

- **PARESTHESIA** = an abnormal sensation, whether **spontaneous or evoked**, which is **NOT UNPLEASANT.**
- **DYSESTHESIA** = an **UNPLEASANT** abnormal sensation, whether **spontaneous or evoked.**
- Feeling of **tingling or formication** in both of them
- **The borderline may present some difficulties** when it comes to deciding as to whether a sensation is pleasant or unpleasant.
- It should always be specified whether the sensations are spontaneous or evoked in both the cases

- !!! Some people prefere the use of one term (*paresthesia*) to indicate spontaneous sensations and the other (*dysesthesia*) to refer to evoked sensations, but such an approache is currently **not favored** (IASP).

SYMPTOMS – HYPERALGESIA, ALLODYNIA

- **SPECIAL CASES OF DYSESTHESIA** include hyperalgesia and allodynia.
- **ALLODYNIA - Pain** due to a **stimulus that does not normally provoke pain**.
- *Allo* means "other" in Greek and is a common prefix for medical conditions that diverge from the expected. *Odynia* is derived from the Greek word "odune" or "odyne".
- the stimulus and the response are in different modes (modalities)

- **HYPERALGESIA** = **Increased pain from a stimulus that normally provokes pain.**
- = reflects increased pain on suprathreshold stimulation.
- the stimulus and the response are in the same mode (modality)

- can be plotted with overlap along the same continuum of physical intensity in certain circumstances, for example, with pressure or temperature.

SYMPTOMS – NEUROPATHIC PAIN

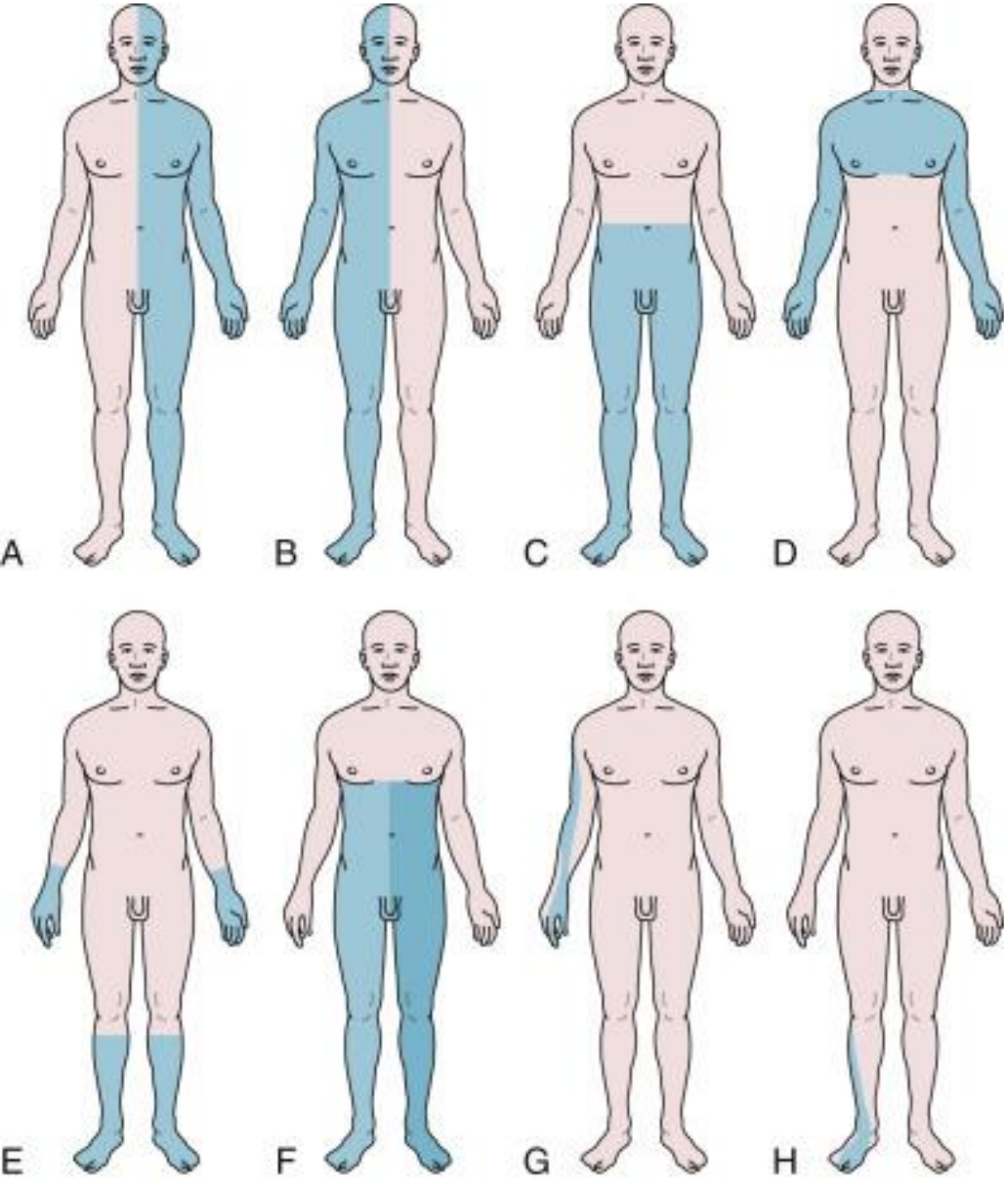
- **caused by a lesion or disease of the somatosensory nervous system** (central or peripheral)
- a clinical description (and not a diagnosis)
- ***lesion or disease*** has to be ***confirmed*** by imaging, neurophysiology, biopsies, lab tests… or a medical history of obvious trauma

- Character: **prickling** (pins and needles) + **shock-like, shooting** + **burning** sensations
- Usually accompanied by persistent tingling and/or numbness
- **Increased at rest** and during the night, usually **decreased during the movement**
- May occur ***spontaneously or with stimulus (allodynia, hyperalgesia)***
- **Continuous or episodic or both**

- Mechanisms: Related to spontaneous activity of sensory axons + *cross-talk* (ephaptic transmission) between damaged axons (allows an action potential in one nerve fiber to be abnormally transmitted to an adjacent nerve fiber) + central (or peripheral) sensitisation
- Elicited when sensory axons or cell bodies are damaged, not related to damage in innervated tissue

SENSORY LOCALISATION

LEVEL OF LESION	FEATURES AND LOCATION OF SENSORY LOSS
Cortical	Sensory loss **in contralateral body**, restricted to the portion of the homunculus affected by the lesion; if the entire side is affected (with large lesions), either the face and arm or the leg tends to be affected to a greater extent
Internal capsule	Sensory symptoms **in contralateral body**, which usually involve head, arm, and leg to an equal extent; motor findings common, although not always present
Thalamus	Sensory symptoms **in contralateral body** including head and may split the midline; sensory loss without weakness highly suggestive of lesion here
Spinal transection	Sensory loss **at or below a segmental level,** which may be slightly different for each side; motor examination also key for localization
Spinal hemisection **(Brown-Séquard)**	Sensory loss ipsilateral for vibration and proprioception (dorsal columns), contralateral for pain and temperature (spinothalamic tract)
Nerve root	Sensory symptoms follow a **dermatomal distribution**
Plexus	Sensory symptoms span **two or more adjacent root distributions**, corresponding to the anatomy of the plexus divisions
Peripheral nerve	Distribution follows **peripheral nerve anatomy** or involves nerves symmetrically



SENSORY LOCALISATION

A) Hemisensory loss as a result of a **contralateral hemispheric** lesion.

B) Hemisensory because of a **contralateral thalamic** lesion

C) Midthoracic spinal sensory level (**spinal transsection**)

D) Dissociated sensory loss to pain and temperature as a result of **syringomyelia**.

E) Distal, symmetrical sensory loss because of **peripheral neuropathy.**

F) Crossed spinothalamic loss on one side with posterior column loss on the opposite side because of Brown-Séquard syndrome (**spinal hemisection**)

G) Dermatomal sensory loss because of cervical **radiculopathy** (C6)

H) Peripheral nerve **lesion** (peroneal).

Modified from: https://www.sciencedirect.com/topics/medicine-and-dentistry/dissociated-sensory-loss

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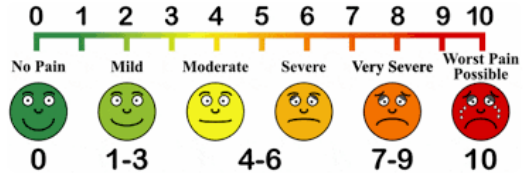
SENSORY EXAMINATION AND HISTORY

- **ALWAYS ASK** the patient about the ***distribution*** of sensory symptoms/pain, pain ***intensity*** (NRS, VAS, FPS…), ***duration, mode of onset, clinical course*** (relapsing-remitting? stable? progressive? short attacs?) + ***what relieves*** the symptoms/ ***makes them worse***?

- Patients frequently **don´t describe** the problems using apropriate words (confuse hypoesthesia with weakness, impaired proprioception causing the instability when walkig may describe as „vertigo“…)!!!;
- patients may **not be aware** of any sensory deficit (vibration, proprioception…);
- the patient **may complain of sensory loss, but examination fails to reveal** a sensory deficit (particularly frequent in the loss of small-fiber functions).



- Remind the **subjective** nature of the clinical examination;
- the subject must be **conscious and cooperating** (sensory deficits can´t be evaluated in unconscious individuals, in case of aphasia, severe cognitive decline and/or non-cooperative patients);
- **inconsistency** in the patient's responses is common (and doesn´t automatically mean malingering).

SENSORY EXAMINATION - PRINCIPLES

- **Be aware of aphasia**, **cognitive** decline, loss of consciousness (**delirium**) or **fatigue**
- The evaluation of the sensory system is completed with the **patient lying supine**
- Testing should **not occur over closing**
- No visual control during the testing (**eyes closed**)
- It´s thus very important that you **first inform the patient** about the purpose of each test, what you plan to do and how he/she should respond to each stimulus.
- In each of the modalities, **start with basic evaluation of whole the body surface**
- Testing should **compare the right and the left** side (even if both sides are affected)
- Testing should **compare distal to proximal areas** (or other „probably affected“ (limbs) and „probably non-affected“ (face) areas)

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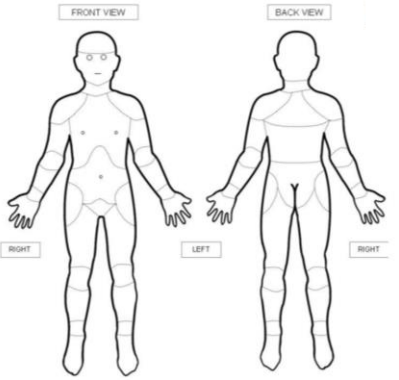
SENSORY EXAMINATION - PRINCIPLES



- The **patterns and pace of the testing should be varied**, so the patients cannot reognize a pattern and respond correctly due to an educated guess
- The further extent of testing depends on the results of such a basic evaluation and on the **PRESENCE/ ABSENCE of SENSORY SYMPTOMS**
- If somatosensory loss is present, **attempt to map the area with distinct boundaries** to best determine the type and extent of the lesion/condition/disease (does the distribution correspond to particular peripheral nerve/ root/ plexus/ spinal level/ hemisecion/ distal distribution related to polyneuropathies?)
- = try to find the **transition between the regions** with normal and abnormal perception of particular modality (touch, pinprick…) (see next slide)
- If possible, mark the areas of somatosensory abnormities in the **body diagram**↑↑↑

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SENSORY EXAMINATION – TRANSITION LINE

- To find the **transition between the regions** with normal and abnormal perception, the testing should be performed **repeatedly, perpendicular** to the expected transition line

- **In spinal lesions**, the **SENSORY LEVEL** is determined by performing an examination of both pin prick (sharp/dull discrimination) and light touch sensation within each of the 28 dermatomes on each side of the body (right and left) (sensory level is the most caudal, normally innervated dermatome) (may be different for the right and left side, Kirshblum et al. 2011)

- **In hemisensory distribution**, **SHARP MIDLINE TRANSITION IS ATYPICAL** (it´s moved 2-4 cm to the affected side due to the transmedian overlaping of cutaneous innervation) (peripheral nerves cross the midline and the innervation overlaps in all the regions - head/neck, thorax/abdomen, back, perineum, and genitalia) (Capek et al. 2015).

Kirshblum SC et al International standards for neurological classification of spinal cord injury. J Spinal Cord Med 2011; 34(6): 535–54.
Capek S, Tubbs RS, Spinner RJ. Do cutaneous nerves cross the midline? Clin Anat 2015;28(1):96-100.

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SENSORY MODALITIES TESTED

- **LARGE-FIBER (DCLM-RELATED) MODALITIES**
  - Vibration
  - Deep presure
  - Discriminative touch (stereognosis, graphesthesia, 2-point discrimination)

    Proprioception: - statesthesia (joint position sense)

    - kinaesthesia (the sense of movement and dynamic position sense)

- **SMALL-FIBER (SPINOTHALAMIC TRACT – RELATED) MODALITIES**
  - Pain (nociception) (sharp mechanical pain – pinprick, thermal pain…)
  - Temperature (warm + cold)
  - Non-discriminative (affective) touch

- **SENSORY THRESHOLD** = the minimum stimulus intensity detected by a subject

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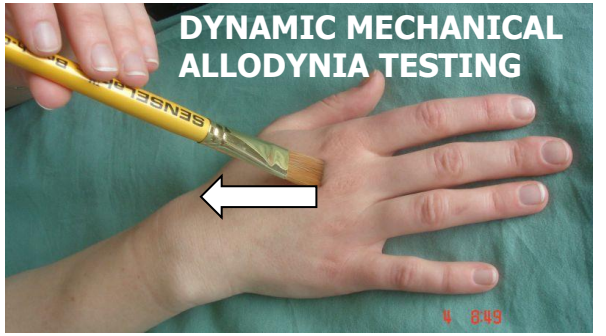
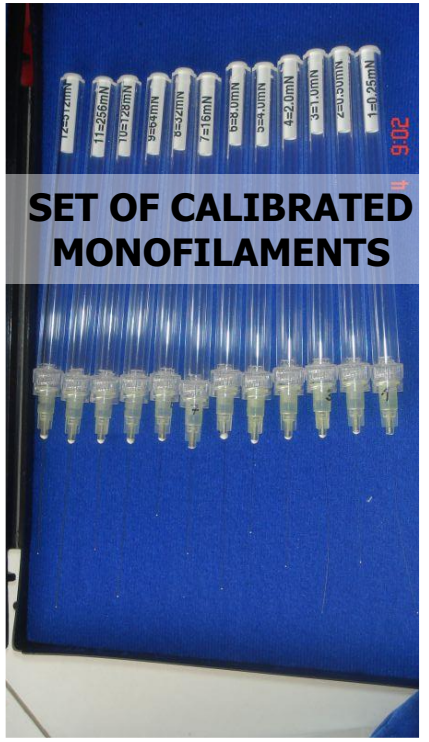
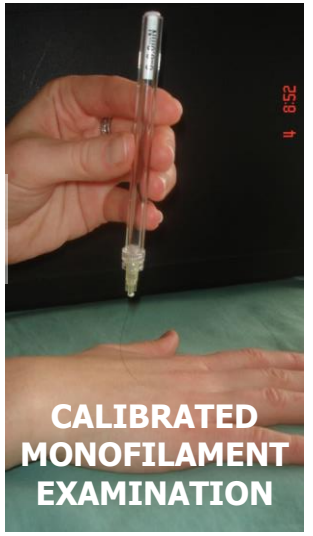
LIGHT TOUCH

- use a **cotton wisp, cotton swab or brush** (or possibly your fingers)
- apply a **gentle touch** (dynamic tactile stimuli are always perceived better than the static ones!!)
- ask the patient to **close their eyes** and report “yes” every time they **perceive** the stimulus.
- Another possibility is to **alternate touching the patient with the needle and the swab/ brush** at intervals of roughly 5 seconds.
- Instruct the patient to **tell the physician if they notice a difference** in the strength of sensation on each side of their body.
- Use of dynamic stimuli also tests for **dynamic mechanical allodynia**
- For quantitative touch assessment, **set of calibrated monofilaments** can be used (**by bending**, each of them produces precisely defined mild pressure/touch on the skin). Most frequently, the 10 g filament is used as a calibrated stimulus (see next slide).







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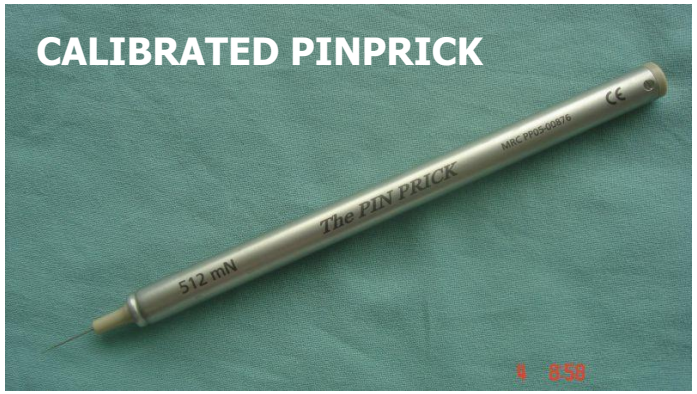
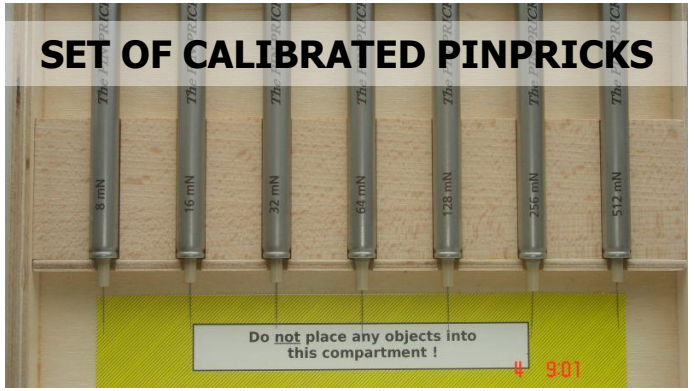
SHARP PAIN

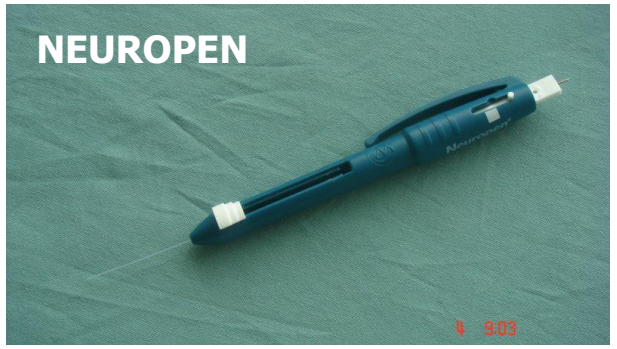
- use a **disposable pin or specific devices:**
- **Neuropen** (Owen Mumford) is a pocket-size device combining:
  - *Calibrated Neurotip test* (40 g) assesses reduced sensation to sharpness/pain in small nerve fibres.
  - *Calibrated monofilament test* (10 g) assesses protective touch/pressure sensation in large nerve fibres
  - Use both devices randomly in any region

- **A set of calibrated pinpricks** allows detailled quantitative testing (mechanical pain threshold can be established)

- In any device used, ask the patient to **close his/her eyes** and **report whether he/she feels the stimulus sharp or dull**.







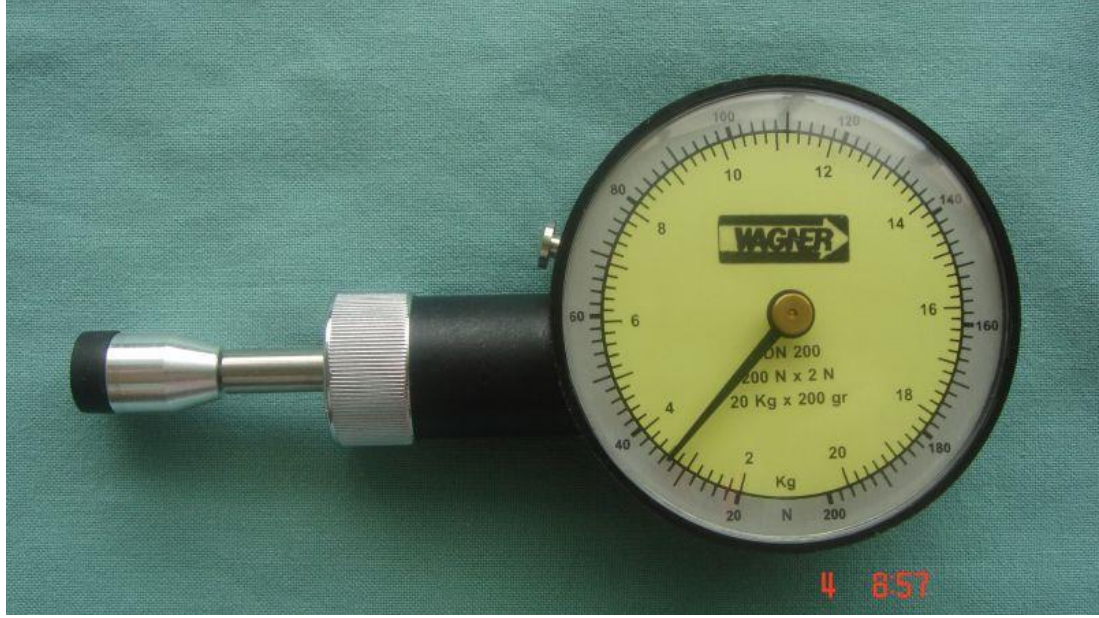
Small fibers, spino-thalamic tracts

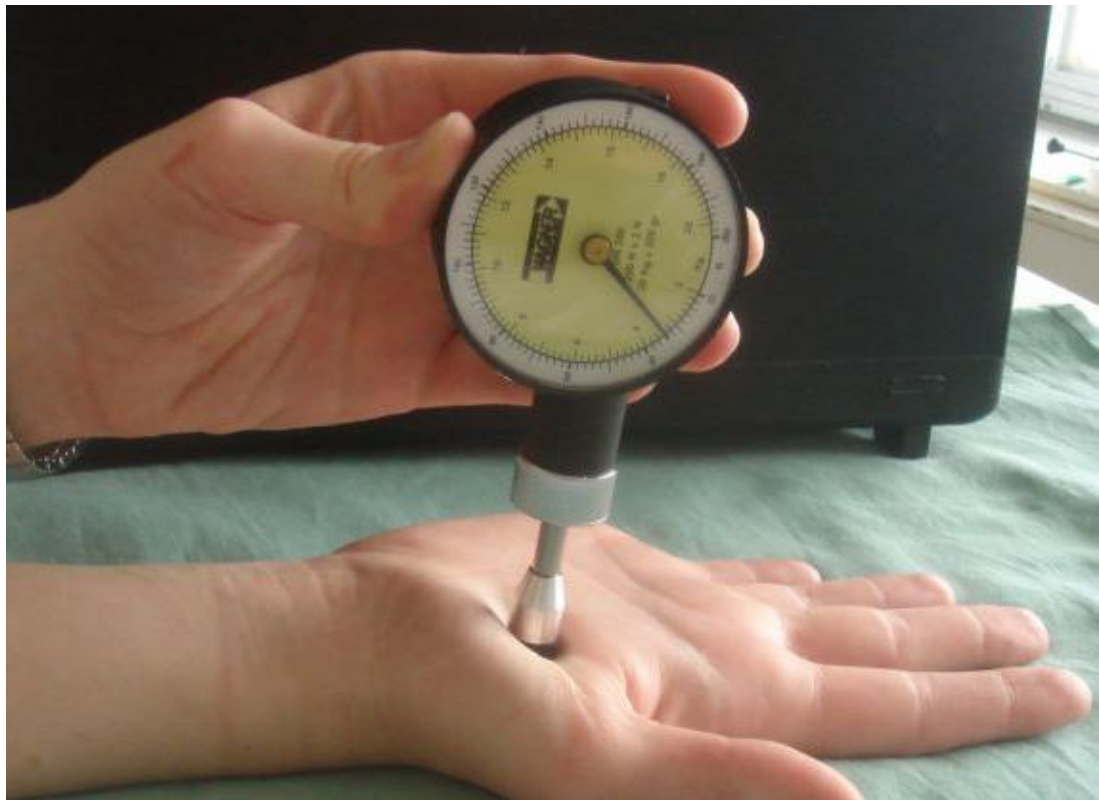
DEEP PRESSURE, PRESSURE PAIN

- **Mainly large fibers, DCLM system**

- **Blunt pressure** applied **on the muscle mass** (thenar eminence….)

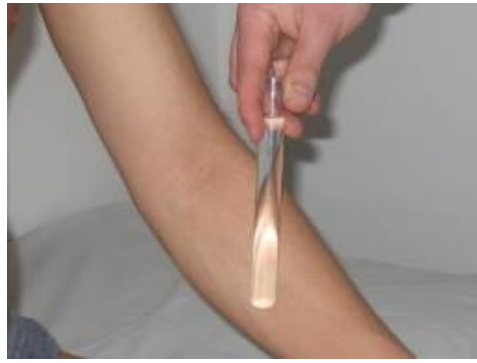
  - e.g. by pressure gauge device – allows quantification of the pressure pain threshold
  - or just by the pressure of examinator´s thumb





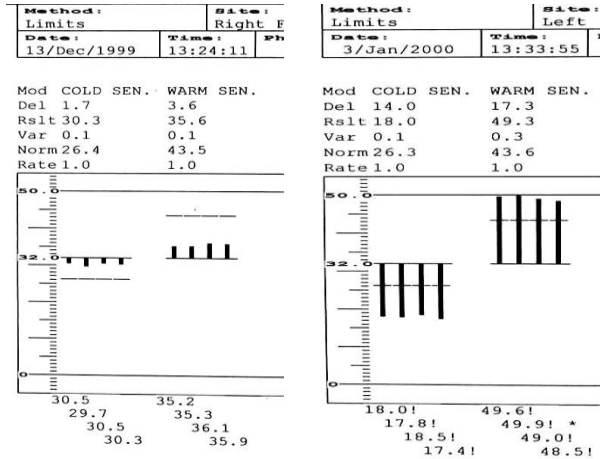
TEMPERATURE (WARM AND COLD)

- **Small fibers, anterolateral (spinothalamic) tracts**
- **TESTING OPTIONS**:
  - random use of the **test tubes filled with hot** (115 to 120 °F, i.e. 46 to 49 °C) **or cold** (40 to 50 °F, i.e. 5 to 10 °C) water.



  - **a cold vibration fork** (if needed, it can be cooled by running it under cold water) and ask the patient if they perceive the vibration fork as cold.

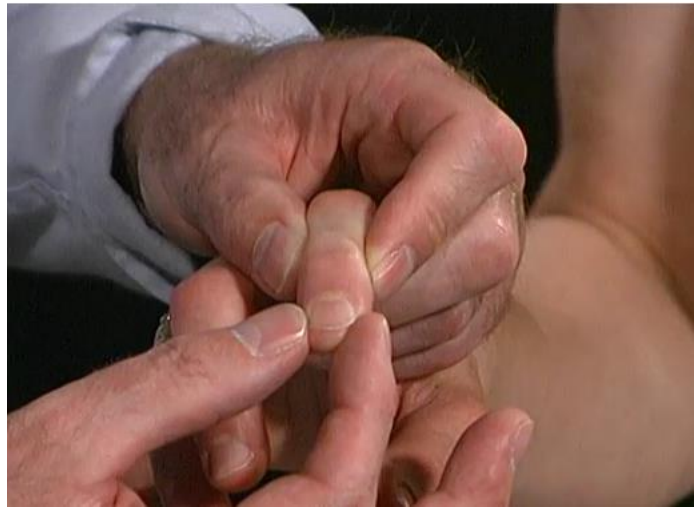
  - **a TipTherm** (Bailey) device - made of special polymer and metal alloys - the polymer side feels warmer and the metal alloy side cooler due to the thermal conductivity property of the materials) – use both sides randomly and always ask the patient if he/she perceives the stimulus as warm or cold



  - **thermal threshold testing** – a quantitative sensory testing method – a thermode with the temperature increasing/decreasing from neutral temperature of 32 °C. Warm/ cold thermal detection threshold (and hot/ cold thermal pain threshold) can be established.

PROPRIOCEPTION (JOINT POSITION SENSE)

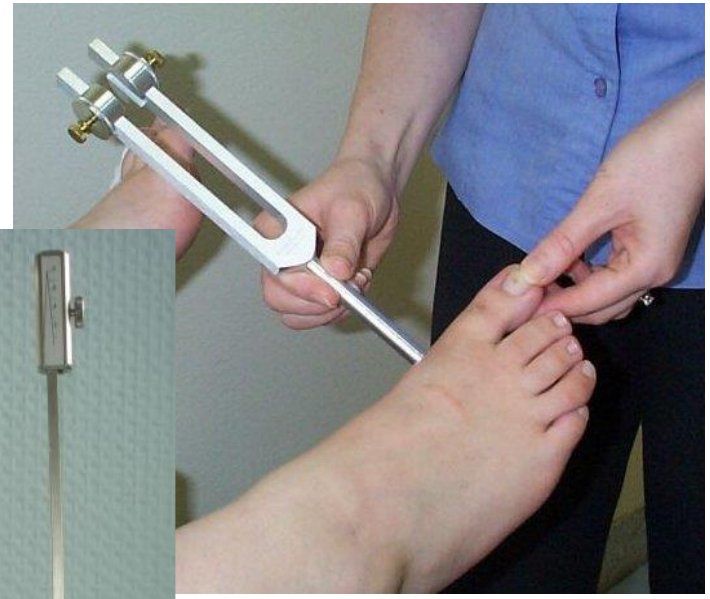
- **Large fibers, DCLM tracts**
- tested by **holding the most distal joint** of a digit and **moving it slightly up or down**. Make certain to **hold the digit on its sides**, because holding the top or bottom provides the patient with pressure cues which make this test invalid. First, **demonstrate** the test with the patient watching so they understand what is wanted then perform the test with **their eyes closed**. The patient should be able to detect 1 degree of movement of a finger and 2-3 degrees of movement of a toe. If the patient can't accurately detect the distal movement then **progressively test a more proximal joint** until they can identify the movement correctly.

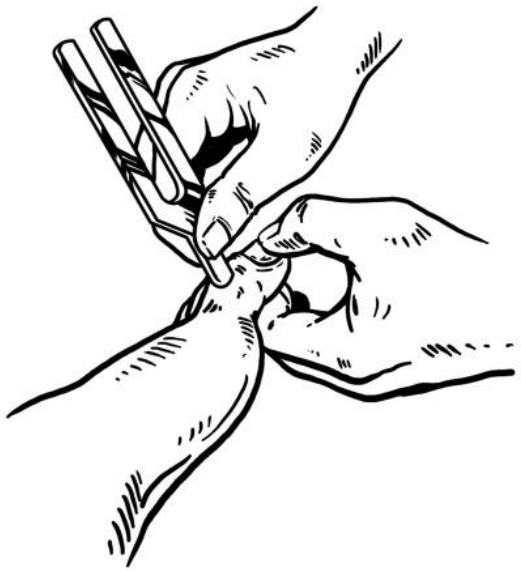


- **Impaired proprioception also causes:**
  - **Loss of ability to walk with eyes closed**
  - **positive Romberg´s sign**
  - **pseudoathetosis** (abnormal writhing movements, usually of the fingers)

SENSE OF VIBRATION (PALLESTHESIA)

- **large fibers, DCLM system**
- use **an oscilating 128 hertz tunning fork**
- place **over bony prominencies** (radial styloid process, tuberosity of the tibia, medial or lateral ankle, the distal phalanx of the index finger or large toe).
- ask the patient **to report whether they feel vibration** sense and then **to report when it stops** in order to assess the minimal threshold to perceive the stimulus.
- **compare to your own** extremities **or use a calibrated** tunning fork and record the number from the scale





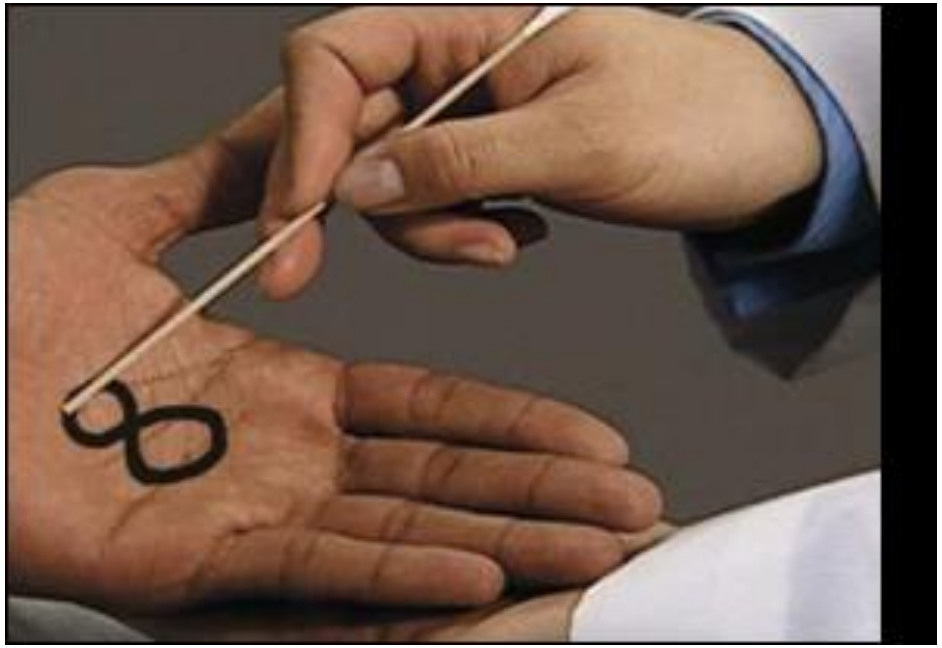
DISCRIMINATION – STEREOGNOSIS

- **large fibers, DCLM system**
- explain to the patient that you will be **placing an item in their hand** which **they should then manipulate** and **identify** with their **eyes closed.**
- stimuli include different coins, a key, a safety pin, a paper clip, a coin, etc.
- Specific kits are available containing a set of objects for the purpose of stereognosis testing (→→→)

DISCRIMINATION – GRAPHESTHESIA

Large fibers, DCLM system

- explain to the patient **that you will be drawing a number in the palm of their hand or other region**
- explain to the patient what is up and down, the distal side is usually up as this is a typical orientation of the palm.
- **demonstrate** with eyes open.
- ask the patient to **close their eyes**.
- with a blunt item such as your fingertip draw a number across the palm and **ask the patient to identify it.**



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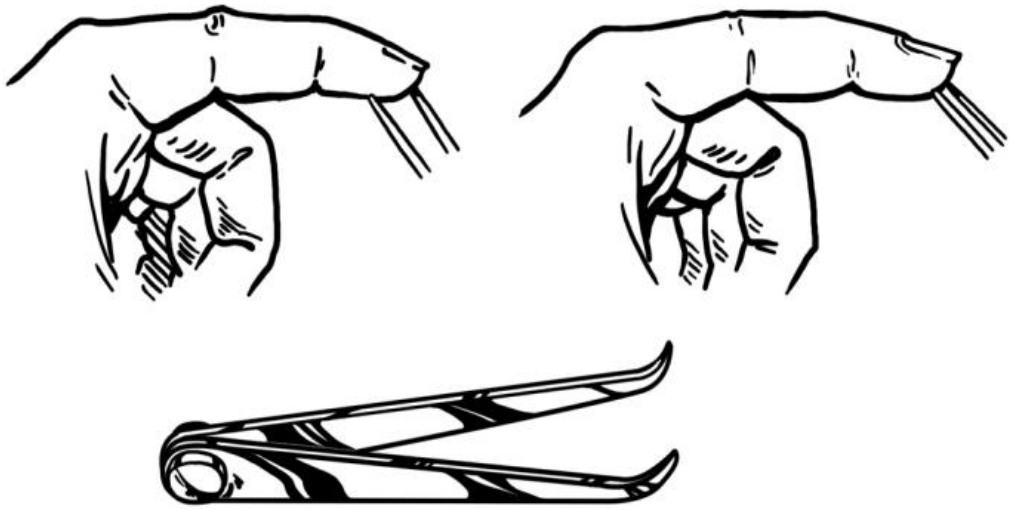
2 POINT DISCRIMINATION



- **large fibers, DCLM system**
- use either calipers or a **opened paper clip** with two parallel ends or **Weber´s compass**
- **demonstrate** to the patient with eyes open by applying **either one or two points** of the stimulus **to the fingerpad.**
- ask the patient to **close their eyes**.
- deliver the stimulus and ask the patient to report whether they feel one or two points.
- **Normal response:** normal values over the **fingerpads are 2-4 mm**.

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TACTILE (SENSORY)EXTINCTION (DOUBLE SIMULTANEOUS STIMULI)

- **EXTINCTION =** neurological sign, **impaired ability to perceive multiple stimuli of the same type simultaneously**. Usually caused by a lesions on one side of the **brain.** Affected patients lack the awareness in the contralesional side of space (towards the left side space following a right lesion) and a loss of exploratory search and other actions normally directed toward that side.
- with eyes open **demonstrate** to the patient that you will touch them on the left side, the right side or both.
- this **should only be done if the patient can perceive a unilateral stimulus** (i.e. if there is loss of pain and temperature or light touch on one side, there would be no point assessing extinction).
- have the patient **close their eyes** and as you deliver a gentle touch, report **whether they feel it on the left side, right side or both sides**.

FUNCTIONAL SENSORY LOSS

The clinical presentations **SUGGESTING FUNCTIONAL SENSORY LOSS** include the following:

- Sensory loss **exactly splitting the midline**, with a minimal transition zone
- **Circumferential** sensory loss around the body or an extremity
- Failure to perceive vibration with a **precise demarcation**
- **Loss of vision or hearing on the same side** of the body as for the cutaneous sensory deficit
- **Total anesthesia**

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MENINGEAL SYNDROME

MENINGEAL SYNDROME - DEFINITION

- Meningeal syndrome groups together **symptoms connected with any pathological irritation of the meningeal envelopes and the cerebrospinal fluid**.

- It accompanies **biological changes** in these components of the nervous system:
  - Meningeal **infammation** (meningitis, meningoencephalitis)
  - Meningeal **hemorrhage** (subarachnoid hemorrhage)
  - Rarely meningeal **carcinomatosis**
  - Very rarely exogenous **intoxication**

- A set of **typical symptoms and signs**
- The signs are mainly associated with a **reflectory tonic contraction of skeletal muscles** (mainly paraspinal muscles, cervical extensors and hip and knee joint flexors)
- The signs may be absent in infants, elderly patients or patients in coma

MENINGEAL SYNDROME – SIGNS

The most important symptoms: **headache, nauzea** + **vomiting, photo/ phonophobia.**

HEADACHE

- the most common, most consistent and **earliest** symptom.
- a consequence of either **intracranial hypertension** or inflammation of structures of the cranial base.
- usually **very intense, violent, diffuse** (sometimes predominantly frontal) and constant (with paroxysms). Can prevent sleep. It is **not relieved by the usual analgesics**
- It is typically **worsened by**:
  - noise (phonophobia)
  - light (photophobia)
  - coughing
  - abdominal pressure
  - flexion of the neck.

MENINGEAL SYNDROME – SYMPTOMS

NAUZEA and **VOMITING**

- **Frequent** symptoms
- Inconsistently, so called „**cerebral' vomiting** can be present
  - it is projectile, unrelated to meals, frequently spontaneous or occurring when the patient changes position.

PHOTO- and **PHONOPHOBIA**

- Quite **common**, particularly in pronounced clinical symptoms

CONSTIPATION

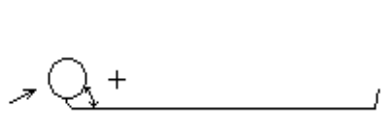
- It used to be mentioned as the third element in the classic meningeal triad (headache, vomiting and constipation).
- It is a rather **irregular** symptom and of **limited practical impact**

MENINGEAL SYNDROME – SIGNS

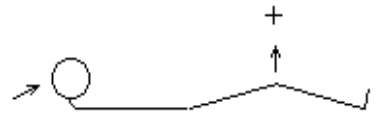
MENINGEAL STIFFNESS

- = a **contracture of the paravertebral muscles**
- a defense against the secondary pain stemming from inflammation of the meninges.
- **Painful and permanent**
- In pronounced clinical pictures, it presents with the subject lying down, curled up with his or her back to the light, head back, the patient's entire spine is hyperextended, and extremities half-bent - an extreme posture called **opisthotonus** (chasing-dog position).
- Frequenty, there is an extreme neck stiffness (called **nuchal rigidity**);
  - all attempts to flex the head provoke insurmountable and painful resistance.
  - rotational and side-to-side movements are possible, but aggravate the headache.

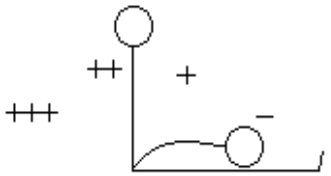
MENINGEAL STIFFNESS CLINICAL TESTS



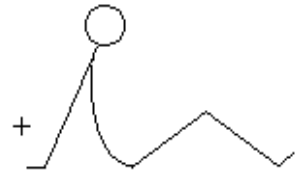
nuchal rigidity



Brudziński´s sign

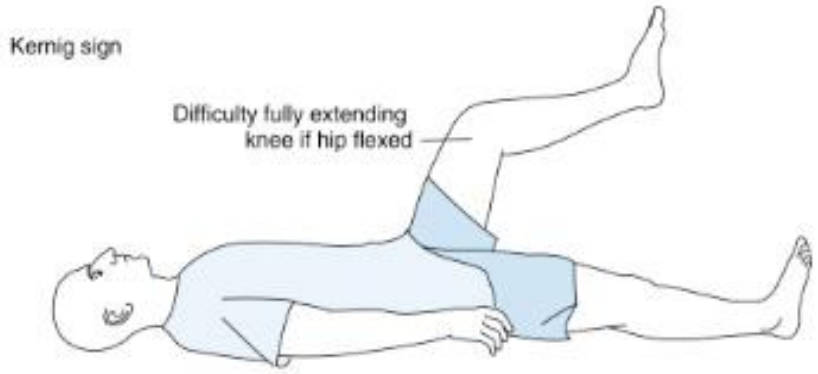


spine sign

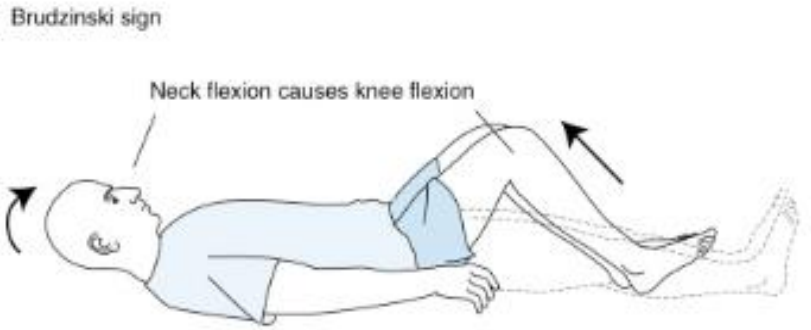


tripod sign (Amoss´ sign)

- Maneuvers that **confirm meningeal stiffness.**
- **KERNIG'S SIGN**
  - The patient resists full extension of the knee when the knee and hip are first flexed (patient's left leg), although the knee extends normally if the hip is extended (patient's right leg).



- **BRUDZINSKI'S SIGN**
  - The flexion of the patient's neck causes the hips and knees to flex, pulling both legs up toward the chest .



- Many people with meningitis don't have the none of these tests positive (Brudzinski, Kernig, nuchal rigidity….).

MENINGEAL STIFFNESS: ACCOMPANYING SIGNS

- **slowing of the cardiac rhythm**
- **cutaneous hypersensitivity**
- the meningeal **mark of Trousseau**: if a line is traced on the skin with a fingernail, a mark appears; initially white, it reddens and then slowly disappears
- **fever**, often elevated and dissociated from the pulse.
- In severe cases the following are seen:
  - **neurological signs** caused by irritation of the underlying nervous system: epileptic seizures, limb paresis, paresis of the cranial nerves (notably oculomotor paralysis), psychiatric disorders.

MAIN SOURCE OF INFORMATION

- Misulis KE. CHAPTER 30 – Sensory Abnormalities of the Limbs, Trunk, and Face. In Bradley WG, Daroff RB, Fenichel GM, Jankovic J. Neurology in Clinical Practice, 5th ed. London: Elsevier 2008.
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- https://www.sciencedirect.com/topics/medicine-and-dentistry/meningism
- Some of the pictures were taken from: Ambler Z, Bednařík J, Růžička E. Clinical Neurology – General Part. Praha: Triton 2004.

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