Anatomy Team 433

SENSORY(ASCENDING)SPINAL TRACTS

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OBJECTIVES

By the end of the lecture, the student will be able to:

Define the meaning of a tract.

Distinguish between the different types of tracts.

Locate the position of each tract.

Describe the sensory pathway.

Identify the different sensory spinal tracts and their functions.

Identify the course of each of these tracts.

Know some associated lesions regarding the main tracts.

Dr. najeeb lectures (mind map اخر ٢٥ دقيقه من رابع فيديو
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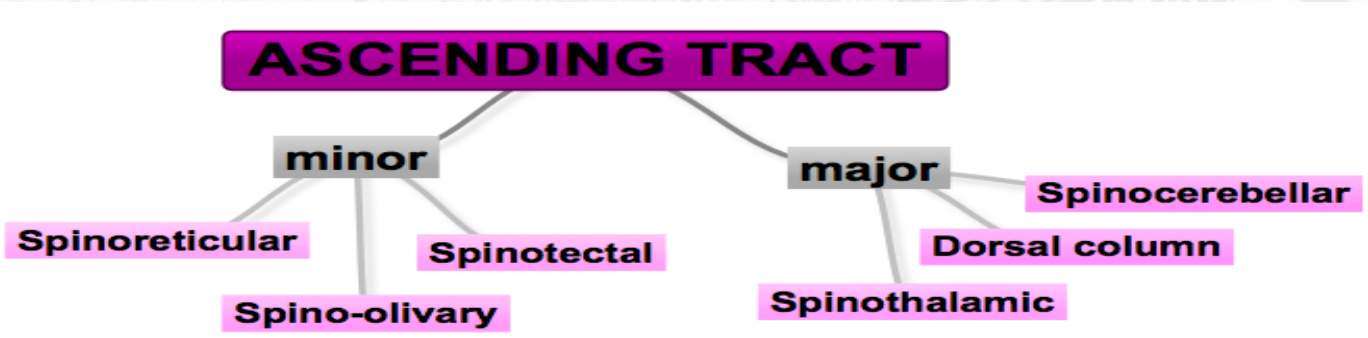
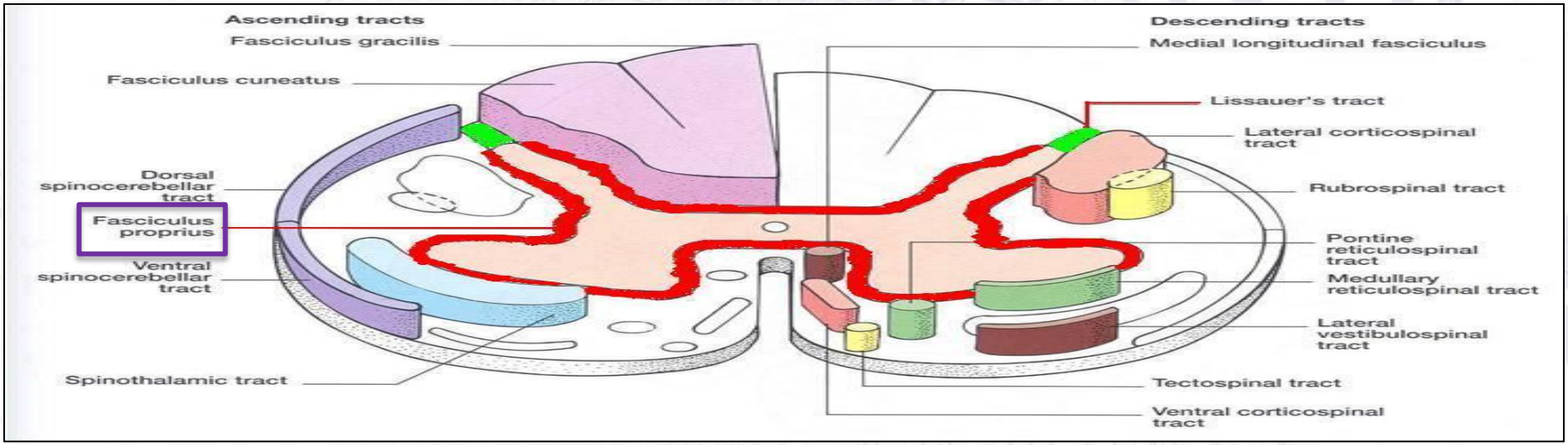


White matter tract

White matter tract:bundle of mylinated nerve fiber that have the same origin,termination and the same function. and divided into dorsal,lateral and ventral funiculi(column)

- Classification of white matter tract
  - Long tract
    - Ascending(sensory) ★
    - Descending(motor)
  - Short tract
    - Intersegmental (propriospinal)
      - Fibers *occupy narrow band immediately peripheral to the grey matter* ***fasciculus proprius***



Ascending Tracts

Carry impulses from pain, thermal, tactile, muscle and joint receptors to the brain.

Some of this information eventually reaches a ***conscious level*** (at the **cerebral cortex)**

while some is destined for ***subconscious centers*** (at the **cerebellum)**

Pathways that carry information to a **conscious level** share certain common characteristics

There is a *sequence of* **Three *Neurones*** between the peripheral receptors and the cerebral cortex.

first-order neurone

- enters the spinal cord through the dorsal root of a spinal nerve and its cell body lies in the **dorsal root ganglion.**

second order neurone

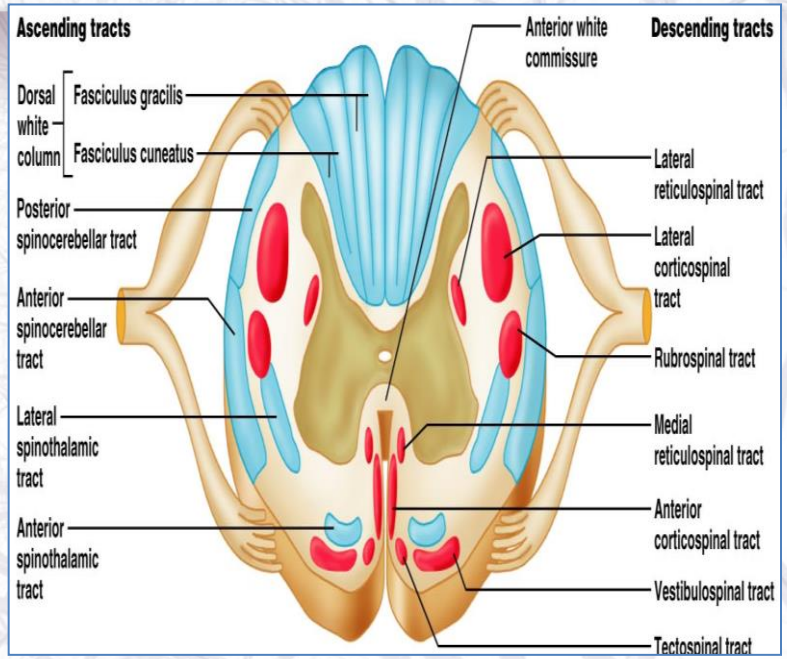
- **lies** either in the **spinal grey matter** or in the **medulla oblongata of the brain stem**
- crosses over (decussates) to the opposite side of the CNS and ascends to the ***thalamus,*** where it terminates.

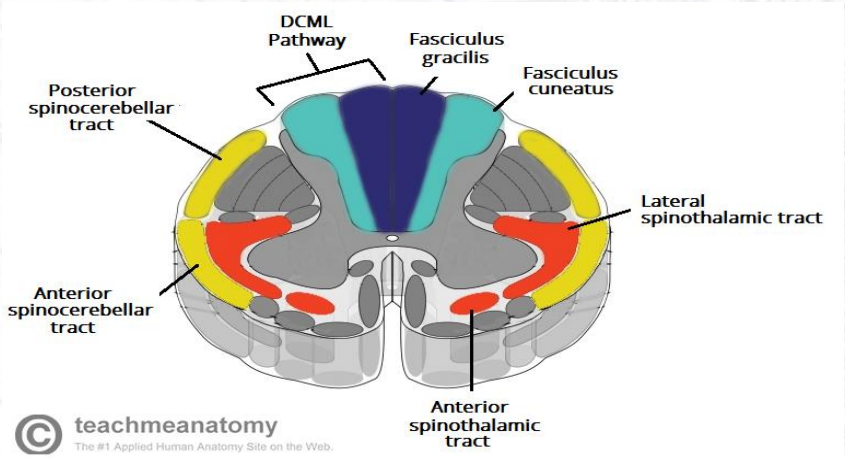
The third-order neurone

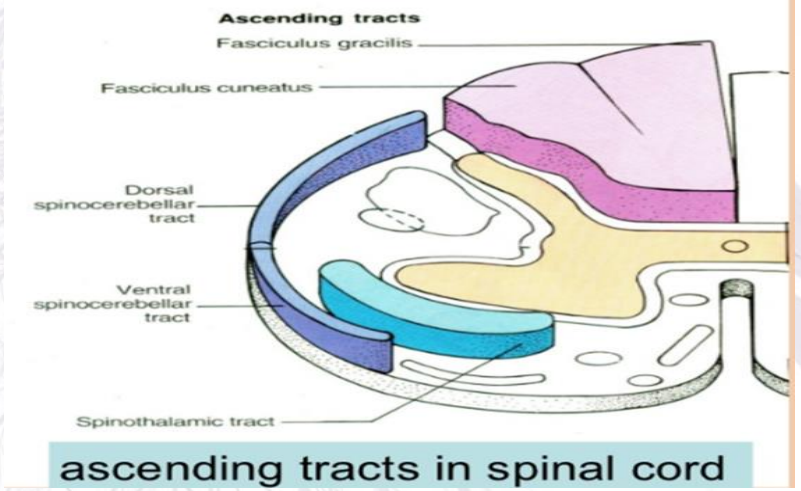
- its cell body in the ***thalamus.***
- Its axon passes to the ***somatosensory cortex*** of the parietal lobe of the cerebral hemisphere.

Three major pathways carry sensory information:

- ***Dorsal (Posterior)column (Gracile & Cuneate fasciculi)*** → Conscious level:terminates in cerebral cortex
- ***Anterolateral pathway (Spinothalamic)***
- ***Spinocerebellar pathway*** → Subconscious level:terminate in cerebellum







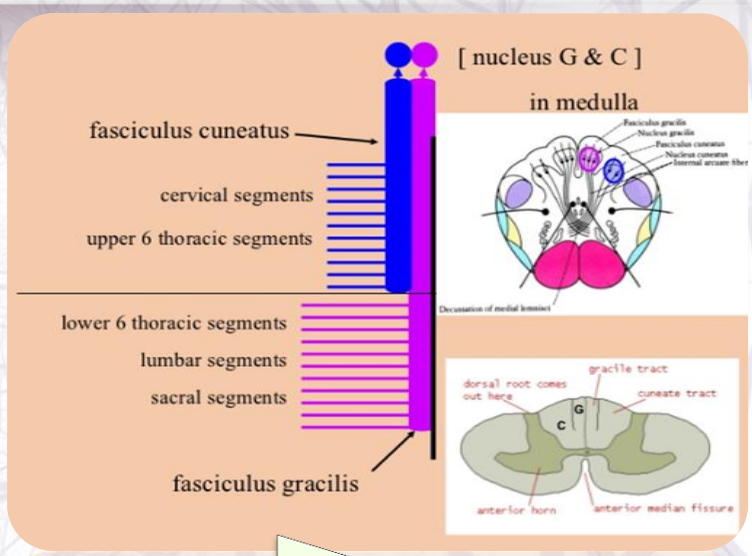
Dorsal Column

Fasciculus Gracilis (FG)

contains fibers that are received at sacral, lumbar and lower thoracic levels,

Fasciculus Cuneatus (FC)

contains fibers that are received at upper thoracic and cervical levels

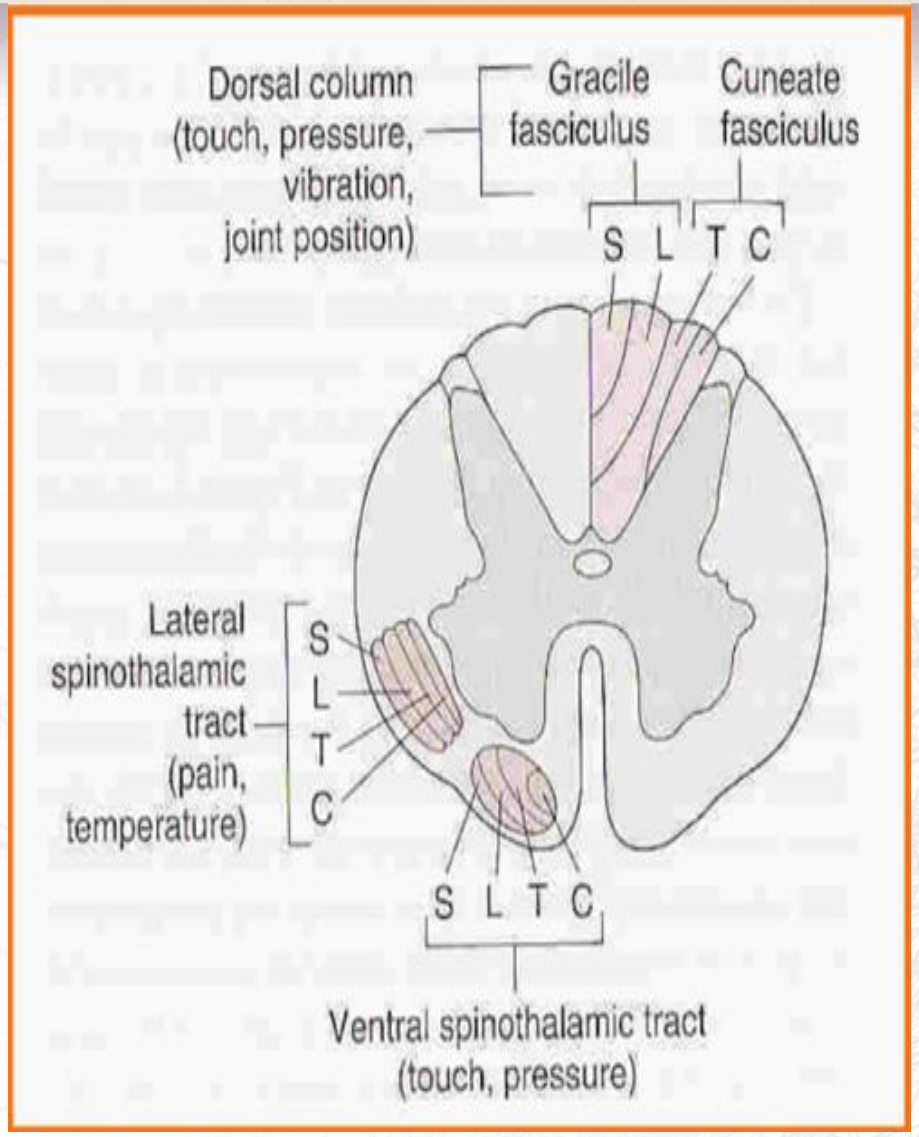


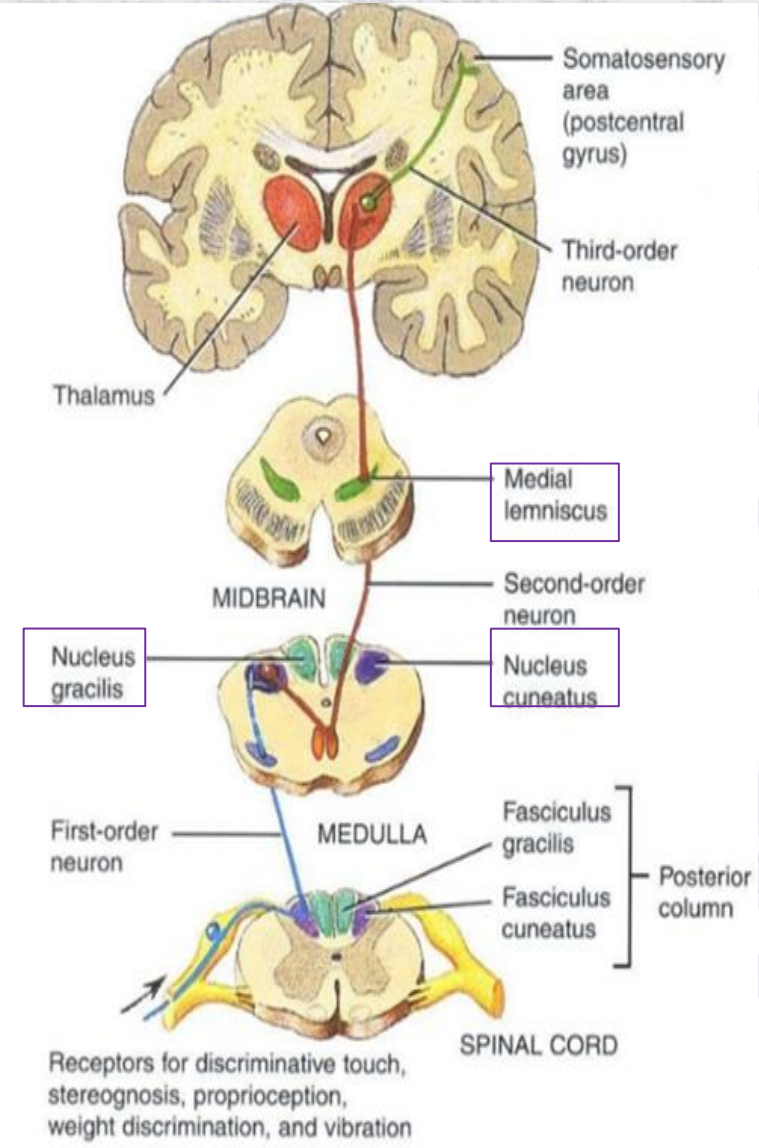
Carry impulses concerned with **proprioception** (movement and joint position) **and discriminative touch** from **ipsilateral side** of the body

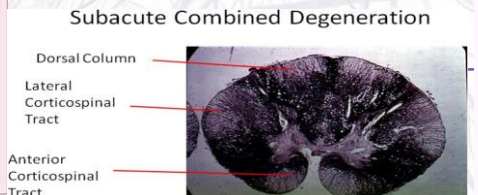
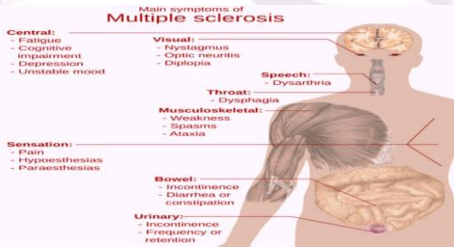
first-order neurone dorsal root ganglion(DRG).

second- order neurone leave the S.C and reach the Brain stem "Medulla" and there are 2 nuclei : nucleus Gracilis and nucleus Cuneatus and crossing happens and named as "Internal arcuate fibers" and ascend through the B.S as " Medial Lemniscus

3rd -order neurons The medial lemniscus terminates in the **ventral posterior nucleus of the thalamus** which project to the somatosensory cortex **(thalamocortical fibers**


Dorsal column
(touch, pressure,
vibration,
joint position)
Gracile
fasciculus
Cuneate
fasciculus
S L T C
Lateral
spinothalamic
tract
(pain,
temperature)
S
L
T
C
S L T C
Ventral spinothalamic tract
(touch, pressure)

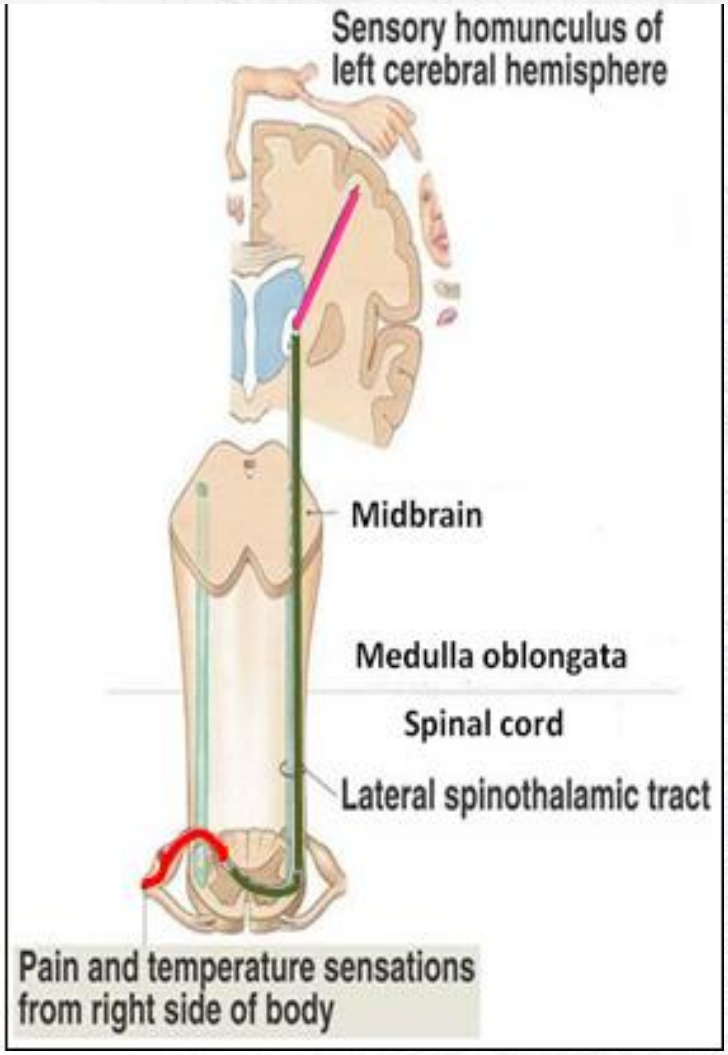

Somatosensory
area
(postcentral
gyrus)
Third-order
neuron
Thalamus
Medial
lemniscus
MIDBRAIN
Second-order
neuron
Nucleus
gracilis
Nucleus
cuneatus
First-order
neuron
MEDULLA
Fasciculus
gracilis
Fasciculus
cuneatus
Posterior
column
SPINAL CORD
Receptors for discriminative touch,
stereognosis, proprioception,
weight discrimination, and vibration

	Tabes dorsalis	Subacute combined degeneration	Multiple sclerosis
pattern	Degeneration of the dorsal column	A systemic disease Combined{Dorsal column(sensory) L.Corticospinal tract(motor)	affects specifically fasciculus cuneatus of the cervical region.
causes	manifestation of syphilitic infection	B12 deficiency	immune disease
symptoms	✓ loss of proprioception ✓ high step page ✓ unsteady gait (sensory ataxia)	B12 deficiency weak and spastic limbs (because Of lateral column)	loss of proprioception in hands and fingers (Asteriognosis)
treatment		with B12 supplements 	

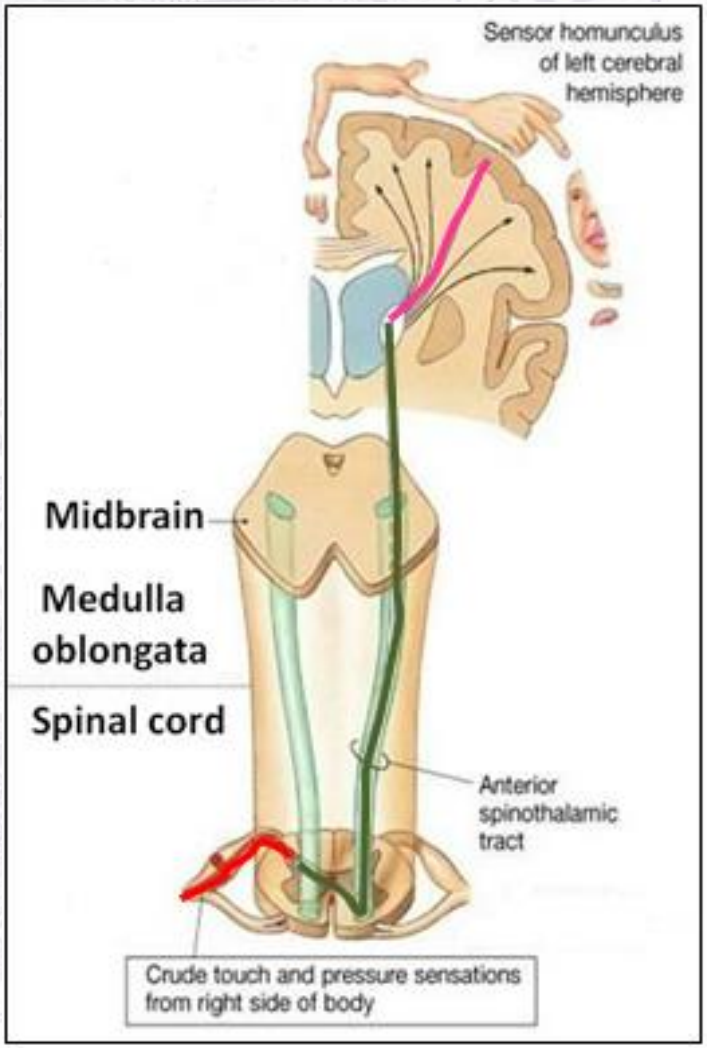
Spinothalamic Tract	Lateral Spinothalamic Tract	Anterior Spinothalamic Tract
	Carries pain & Temperature	Carries crude touch & pressure
Neurone I:	Small cells in the dorsal root ganglia.	Medium sized cells in the dorsal root ganglia
Neurone II	Cells of substantia gelatinosa of Rolandi in the posterior horn.	Cells of main sensory nucleus or (nucleus proprius
Neurone III	Cells of ventroposterior(VP) nucleus of the thalamus.	Cells of VP nucleus of thalamus

Fibres decussate in the **anterior white commissar**
In brain stem, the two tracts constitute the **spinal lemniscus**.
Information is sent to the primary sensory cortex on the opposite side of the body.
The spinothalamic tracts contain axons of ***second-order neurones***, the cell bodies of which lie in the ***contralateral*** dorsal horn

Lateral Spinothalamic Tract



Anterior Spinothalamic Tract



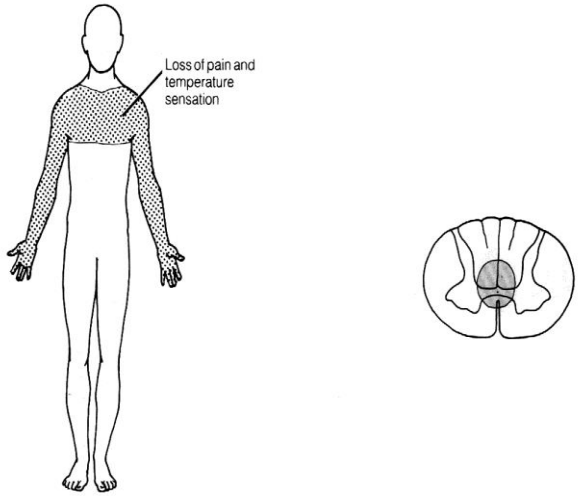


Figure 5–17. Syringomyelia involving the cervicothoracic portion of the spinal cord.

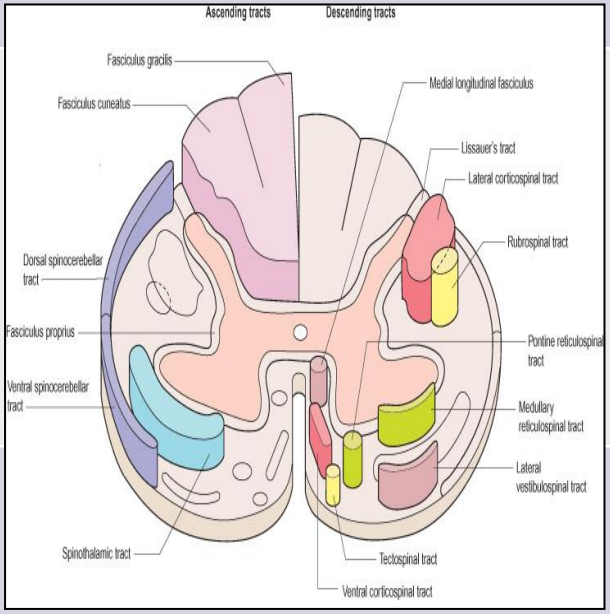
Spinothalamic Tracts Lesion

damaged in **Syringomyelia**

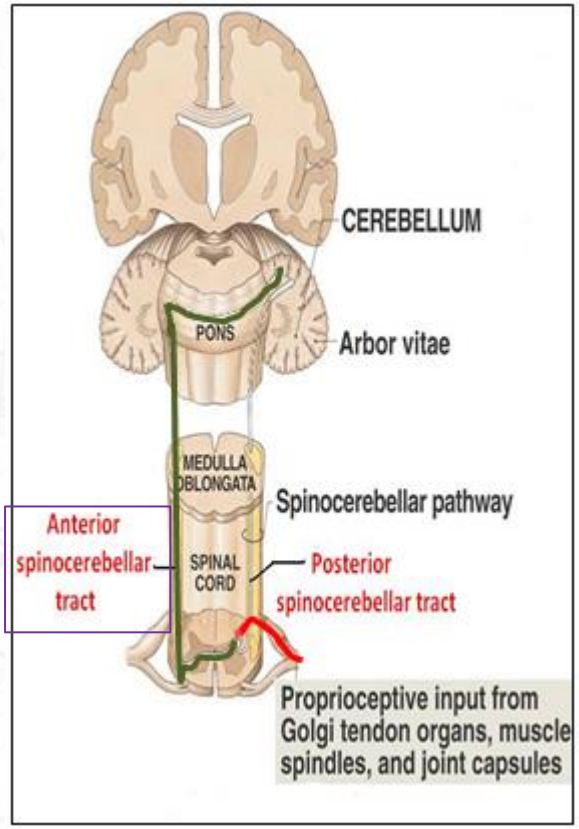
Symptoms

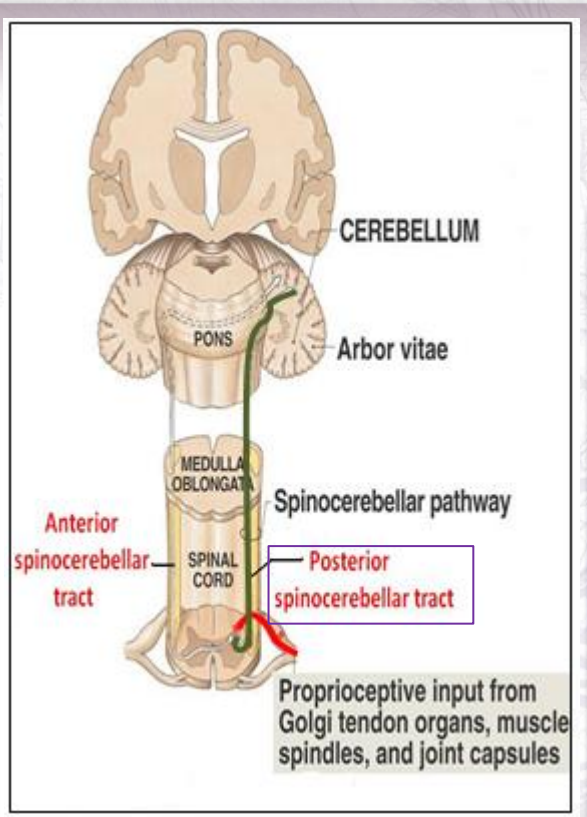
- central canal becomes enlarged
- cavity compressing the adjacent nerve fibres
- the ventral white commissure close to the central canal causing selective loss of pain and temperature in the upper limbs (dissociate sensory loss)
- Light touch and proprioceptive sensations are retained
- Joints of the limbs become disorganized without discomfort **(Charcot's joint)**

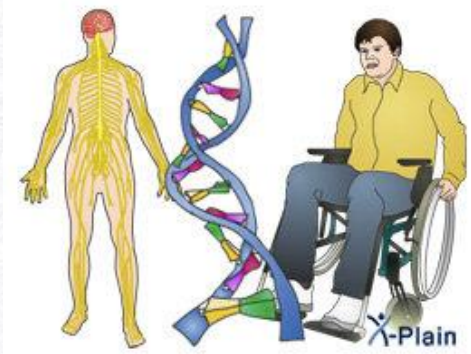
Spinocerebellar Tract

	Posterior Spinocerebellar Tract	Ventral (Anterior)Spinocerebellar Tract
	present only above level L3	
Neurone I	Large cells of dorsal root ganglia.(DRG)	Large cells of dorsal root ganglia. .(DRG)
Neurone II 	cells of the nucleus dorsalis; Clark's nucleus	lie in base of the dorsal horn of the lumbosacral segments
	The axons ascend ipsilaterally to enter the cerebellum through the inferior cerebellar peduncle	Axons of 2nd order neuron cross to opposite side, ascend as far as the midbrain, (the fibers cross the midline for the second time) and then make a sharp turn caudally and enter the superior cerebellar peduncle
	convey sensory information to the same side of cerebellum	convey sensory information to the same side of the cerebellum

Lesion of the Spinocerebellar Tracts







Friedrichs ataxia

- An inherited degenerated disease
- Affecting the spinocerebellar tracts
- Leading to incoordination of arms, intense tremor, wide base reeling gait ataxia
- It begins in child hood
- Wheelchair is bound by 20 years of age

MAINOR TRACTS

Spinotectal Tract	Spinoreticular Tract	Spino - olivary Tract
Ascends in the anterolateral part with spinothalamic system.	Originated in the dorsal horn	Indirect spinocerebellar pathway
Primary afferents reach dorsal horn through dorsal roots and terminate on 2nd order neurons(lie in base of the dorsal horn.) Axons of 2nd order neuron cross to opposite side, and project to the periaqueductal gray matter and superior colliculus in the midbrain	Uncrossed fibers that end in medullary reticular formation Crossed,uncrossed fiber terminate in pontine reticular formation	Impulses from the spinal cord are relayed to the cerebellum via inferior olivary nucleus Conveys sensory information to the cerebellum. Fibers arise at all levels of the spinal cord.
Integrate visual and somatic sensory information(it brings about the movement of eyes and head toward the sourse of information	Involved in arousing consciousness in the reticular activating system through cutaneous stimulation. (dull – ache- pain not sharp pain).	Contribute to movement coordination associated primarily with balance

SUMMARY

Pathway/tract	Sensation(s)	Location of Neuron Cell Bodies				
		First-Order	Second-Order	Third-Order	Final Destination	Site of Crossover
Fasciculus Gracillis	Propriception and fine touch, pressure and vibration, **all from inferior half of body**	Dorsal root ganglia. Axons enter CNS in dorsal roots and join fasciculus gracilis	**Nucleus grascilis** of **medulla oblongata**. Axons cross over before exiting medial lemniscus	**Ventral Nuclei** of **thalamus**	Primary sensory cortex (on opposite side of stimulus)	Axons of second order neurons cross over before entering the medial meniscus
Fasciculus Cuneatus	Propriception and fine touch, pressure and fine touch **from superior half of body**	Dorsal root ganglia. Axons enter CNS in dorsal roots and join fasciculus cuneatus	**Nucleus cuneatus** of **medulla oblongata**. Axons cross over before exiting medial lemniscus	**Ventral Nuclei** of **thalamus**	Primary sensory cortex (on opposite side of stimulus)	Axons of second order neurons cross over before entering the medial meniscus
Lateral spinothalamic tracts	Pain and temperature	Dorsal root ganglia, axons enter CNS in dorsal roots	Interneurons in dorsal horn. Axons enter lateral spinothalamic tract on **opposite** side	**Ventral Nuclei** of **thalamus**	Primary sensory cortex (on opposite side of stimulus)	Axons of second order neurons at level of entry to CNS
Anterior Spinothalamic tracts	Crude touch and pressure	Dorsal root ganglia, axons enter CNS is dorsal roots	Interneurons in dorsal horn. Axons enter lateral spinothalamic tract on **opposite** side	**Ventral Nuclei** of **thalamus**	Primary sensory cortex (on opposite side of stimulus)	Axons of second order neurons at level of entry to CNS
Posterior Spicocerebellar tracts	Propriception	Dorsal root ganglia, axons enter CNS is dorsal roots	Interneurons in dorsal horn. Axons enter lateral spinothalamic tract on **same** side	Not present	Cerebellar cortex on side of stimulus	None
Anterior Spinocerebellar tracts	Propriception	Dorsal root ganglia, axons enter CNS is dorsal roots	Interneurons in dorsal horn. Axons enter lateral spinothalamic tract on **same** side	Not present	Cerebellar cortex on side of (and opposite of) stimulus	Axons of most second order neurons corss over before entering tract: many recross at cerebellum

NOTE:

- The gray matter of the SC. is completely surrounding by the white matter

- ascending tracts are also known as somatosensory pathways or systems.

All ascending tracts are subconscious level except dorsal column tract , spinothalamic tract(conscious level)

- fasciculus cuneatus (the lateral part of the dorsal column
- fasciculus gracilis (the medial part of the dorsal column).

- Medial lemniscus =internal arcuate fibers = axon of 2order neuron of gracilus and cuneatus (crossing of axon)
- Spinal lemniscus = (spinotectal , anterior & lateral Spinothalamic Tract)

Spinocerebeller Carry information derived from muscle spindles, Golgi tendon organs and tactile receptors to the cerebellum for the control of posture and coordination of movements

- ipsilateral : Located on or affecting the same side of the body.
- Contralateral: Taking place or originating in a corresponding part on an opposite side.
- The dorsal-column/medial-lemniscal system contains secondary neurons that cross at the level of the medulla

- Whenever there is crossing that means the right side will control the opposite side and visa versa and if we have 2crossing like (ventral spinocerebeller tract) it will control the same side

Question?

1-Which major ascending pathway (tract) is involved in the conscious perception of external stimuli?

A) spinocerebellar B) spinoolivary E) spinoreticular
C) spinotectal D) spinothalamic

2-Which ascending spinal pathway (tract) carries pain and temperature information to the cerebral cortex?

A) lateral spinothalamic B) posterior spinocerebellar E) spinotectal
C) anterior spinothalamic D) spinoolivary

3-Which ascending spinal pathway (tract) carries light touch, pressure, tickle, and itch sensation to the cerebral cortex?

A) lateral spinothalamic B) posterior spinocerebellar E) spinotectal
C) anterior spinothalamic D) spinoolivary

4-Which ascending spinal pathway (tract) carries the sensations of two-point discrimination, proprioception, pressure and vibration?

A) lateral spinothalamic B) posterior spinocerebellar E) spinotectal
C) anterior spinothalamic D) dorsal-column/medial-lemniscal system

Question?

5. The anterior spinocerebellar tract is usually found in the most _____ part of the spinal cord?

A)medial B)lateral C) ventral D)rostral

6-Which is true of the spinothalamic tracts?

A) contain primary neurons that enter the spinal cord and synapse with secondary neurons

B) contain secondary neurons that cross the spinal cord, ascend to the thalamus, and synapse with tertiary neurons.

C) contain tertiary neurons that project to the somatic sensory cortex

D) all of the above

7-Which of the following ascending sensory pathways (tracts) contains secondary neurons that cross at the level of the medulla?

A) lateral spinothalamic B) anterior spinothalamic

C) dorsal-column/medial-lemniscal system D) posterior spinocerebellar

8-Which of these spinal pathways carries information from the right side of the body to the right side of the brain?

A) anterior spinothalamic system B) lateral spinothalamic system E) medial lemniscal system

C) spinocerebellar system D) anterior corticospinal system

Question?

9-Fasciculus gracilis and quneatus are concerned with ……..?

A)pain B)pressure

c)discriminative touch

10)Intersegemental coordination is a feature of which tract ?

A)Spinothalamus B)spinotectal

C)Short tract D)spino-olivary

11- Descending (motor) tracts are found mostly in the _____ areas of the spinal cord?

A) lateral B)caudal C)dorsomedial D)anterior

12- the spinothalamic tract carries mainly ?

A)sensory fibers for pain, temperature, pressure, tickle, itch and light / heavy touch.

B)sensory fibers for proprioception, temperature, crude touch, fast pain and vibration

C)motor fibers for visceral organs (autonomic nervous system)

D)motor fibers for skeletal muscle and special motor neurons

1	2	3	4	5	6	7	8	9	10	11	12
D	A	C	D	C	D	C	C	C	C	D	A