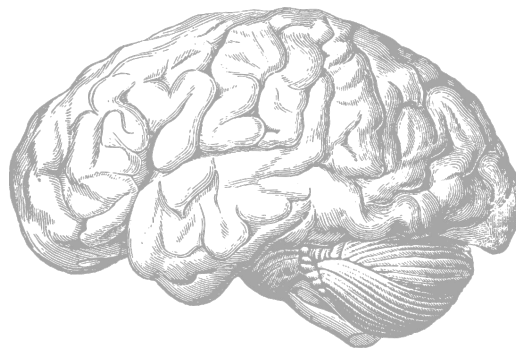




Sensory Tracts

CNS Block



Color Index








- ◆ Main Text
- ◆ Female Slides
- ◆ Male Slides
- ◆ Drs' Notes
- ◆ Important
- ◆ Extra info

[The Editing File](#)





Objectives

-  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.



You can find Atlas by [Clicking HERE!](#)

Introduction

A

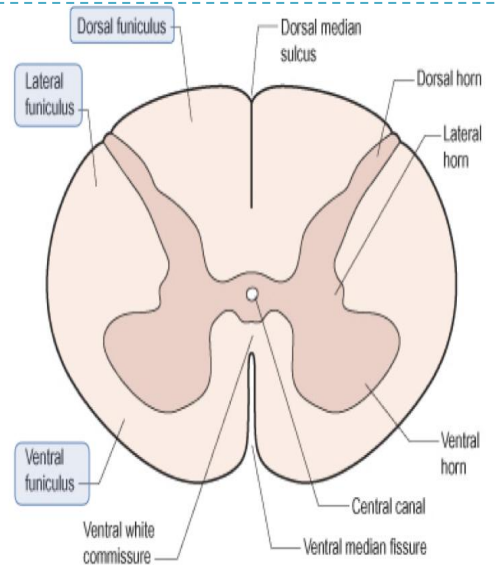
The Gray matter of the spinal cord is completely surrounded by the white matter.

B

The White matter of the spinal cord consists of Ascending and Descending Nerve Fibers.

C

It is divided into: Dorsal, Lateral & Ventral Columns or Funiculi.

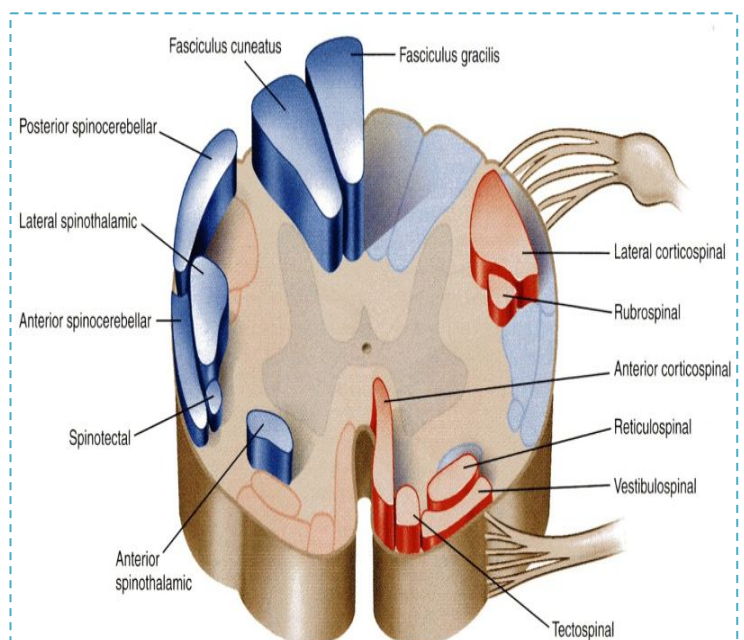


White Matter Tracts

- ❖ Bundles or fasciculi of fibers that occupy definite positions in the white matter.
- ❖ They have the same Origin, Termination and carry the same Function.

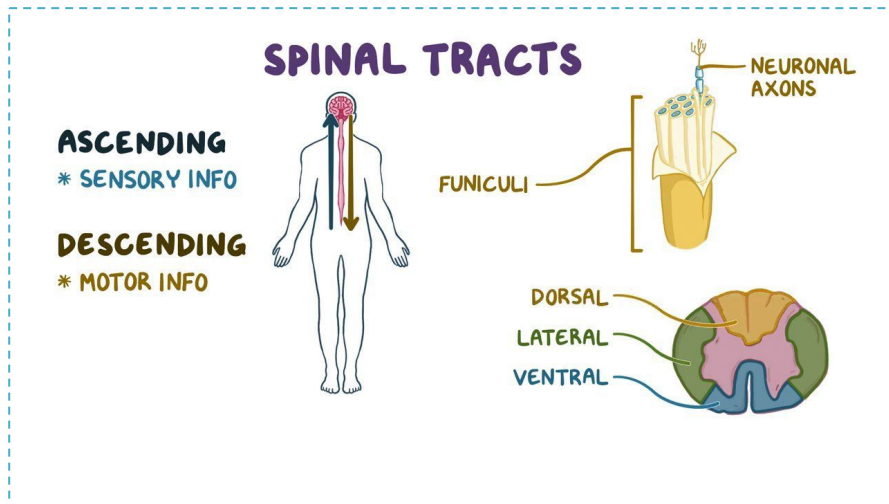
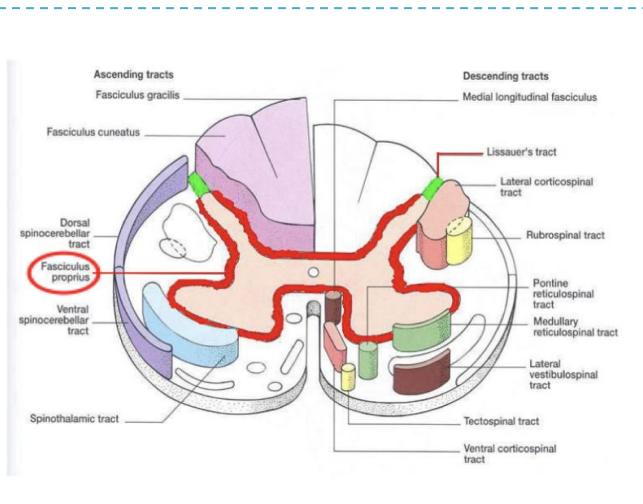


All ascending tracts are sensory, but each relays a certain type of sensation (e.g. temperature, pain, proprioception, etc.) 441*



Classification of White Matter Tracts

	Short Tracts (Intersegmental or ProprioSpinal)	Long Tracts
Function	Interconnect adjacent or distant spinal segments & permit intersegmental coordination.	Join/connect the brain to the spinal cord.
Example	<p>Fasciculus Proprius: Fibers are found close to the gray matter.</p>	<p>Types:</p> <ol style="list-style-type: none"> 1) Ascending (sensory or afferent). 2) Descending (motor or efferent).



Ascending Tracts

Carry impulses of pain, temperature, touch, tactile, muscle, and joint receptors to the brain.

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

While some is destined for **subconscious centers** (e.g. the cerebellum).

Conscious Sensation Pathway

Definition

Pathways that carry information to a conscious level of sensation.

They decussate (cross) to the contralateral side.

There is a sequence of 3 neurons between the peripheral receptors & the cerebral cortex.

First Order Neuron (Primary Afferent Neuron)

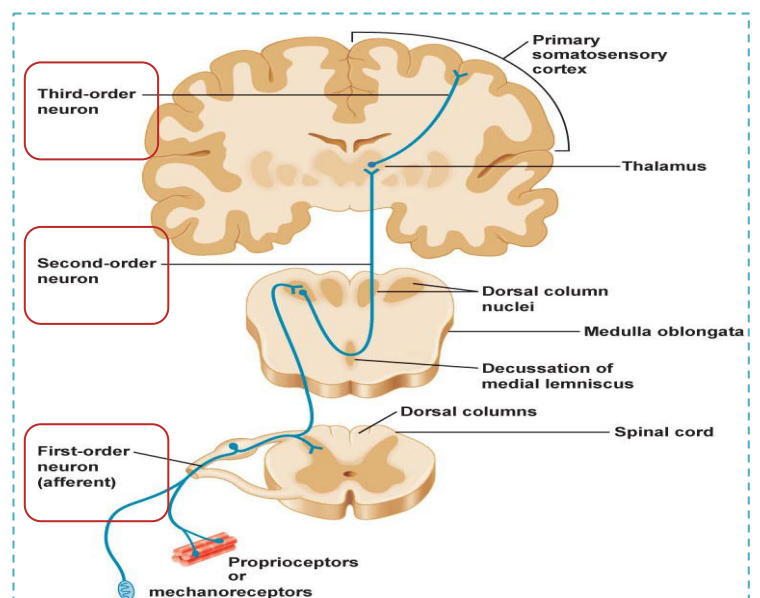
- Enters the spinal cord through the dorsal root of a spinal nerve.
- Its cell body lies in the **dorsal root ganglion**.
- Main fiber **remains on the ipsilateral** (same side) **side of the cord** and terminates in synaptic contact with the second neuron.

Second Order Neuron

- Lies either in the **spinal grey matter** or the **medulla oblongata** of the **brain stem**.
- The axons of the 2nd order neuron **crosses over (decussates)** to the **opposite side of the CNS** and ascends to the thalamus, where it terminates.

Third Order Neuron

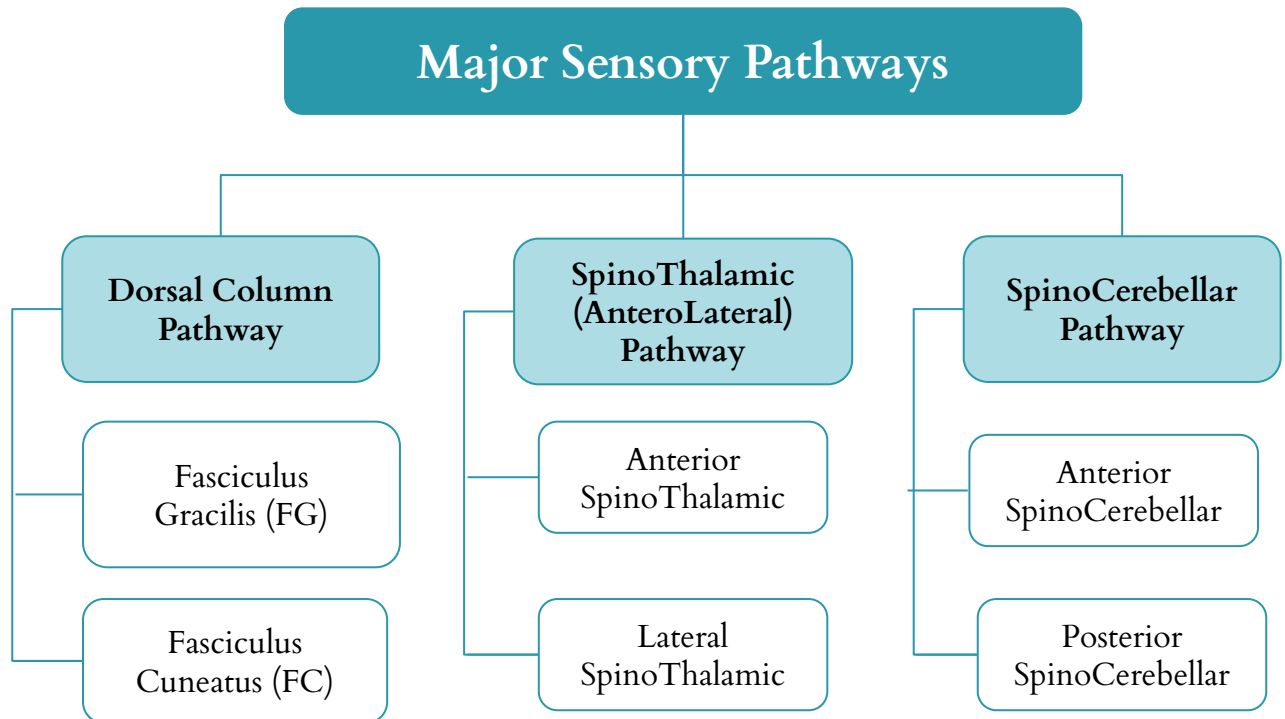
- Has its **cell body in the thalamus**.
- Its axon passes to the somatosensory cortex of the parietal lobe of the cerebral hemisphere.



(a) Dorsal column-medial lemniscal pathway

Ascending Tracts

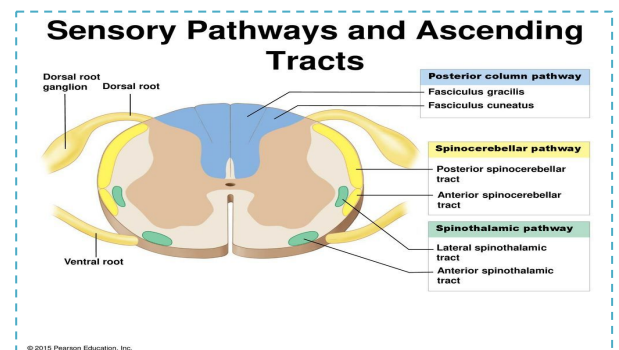
Major Ascending Tracts



The major sensory pathways in the nervous system are named based on the direction in which they transmit sensory information to the brain.

Other Ascending Tracts

- 1 SpinoTectal Tract (Midbrain)
- 2 Spino-Olivary Tract (Medulla Oblongata)
- 3 SpinoReticular Tract (Reticular Formation)



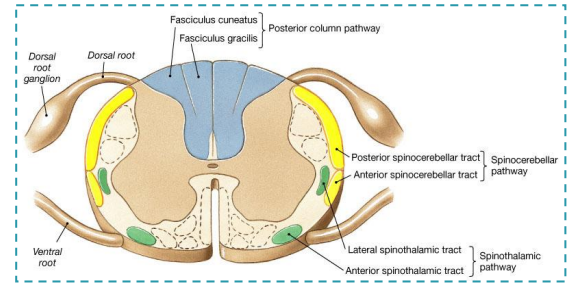
Dorsal Columns



[Click here](#)

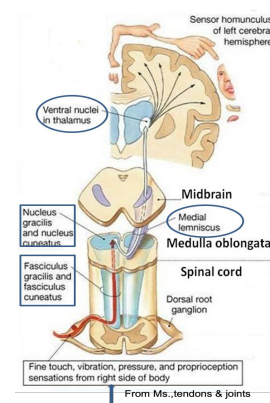
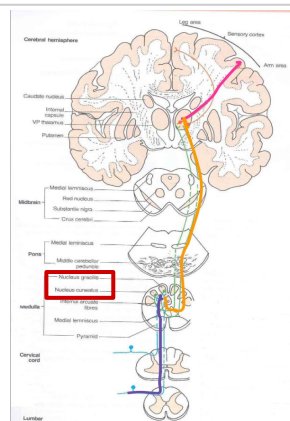
1 Fasciculus Gracilis

2 Fasciculus Cuneatus



		Fasciculus Gracilis	Fasciculus Cuneatus
Receive Fibers From		<ul style="list-style-type: none"> ▸ Sacral level ▸ Lumbar level ▸ Lower thoracic levels 	<ul style="list-style-type: none"> ▸ Upper thoracic levels ▸ Cervical level
1st order neuron	Cell body	Formed by cells of dorsal root ganglion.	
	Axon	<ul style="list-style-type: none"> ▸ Axons enters the cord through dorsal roots of spinal nerves. ▸ Fibers ascent without interruption where they terminate upon 2nd order neuron. 	
2nd order neuron	Cell body	Nucleus gracilis and nucleus cuneatus in Medulla Oblongata.	
	Axon	<ul style="list-style-type: none"> ▸ The axons decussate in the medulla as internal arcuate fibers. ▸ They Ascend through the brainstem as medial lemniscus. 	
3rd order neuron	Cell body	The medial lemniscus terminate in the ventral posterior nucleus of the thalamus .	
	Axon	Project to the somatosensory cortex via thalamocortical fibers .	
Function		Carry impulses from the ipsilateral side of the body concerned with: <ul style="list-style-type: none"> ▸ Proprioception (sense of movement and sense of joint position). ▸ Discriminative touch. 	

Picture



Applied Anatomy

Dorsal Column Lesions

SpinoThalamic Tract Lesions

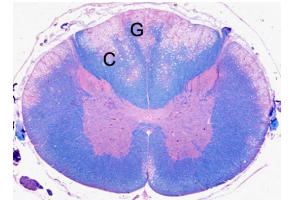
SpinoCerebellar Tract Lesions

Tabes Dorsalis

- ▶ A late manifestation of **syphilitic infection** on the CNS that leads to **degenerative changes of nerve cells & fibers** that carry sensory information to the brain.
- ▶ **Affects:** The **lumbosacral dorsal spinal roots & dorsal column of the spinal cord**.
- ▶ **Leads to:** **Loss of proprioception**, which is manifested by a **high steppage gait & unsteady gait (sensory ataxia)**.

Symptoms:

- ▶ Abnormal sensations as paresthesia (tingling).
- ▶ Problems in the walking.
- ▶ Loss of coordination & reflexes.
- ▶ Muscle weakness.

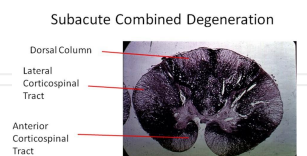


Subacute Combined Degeneration (SCD) of the Spinal Cord

- ▶ A systemic disease resulting from **vitamin B12 deficiency**.
- ▶ It produces **sensory ataxia**.
- ▶ **Lateral column** are also affected (combined), causing **weak and spastic limbs**.

Treatment:

- ▶ It is completely recovered by proper treatment with vitamin B12 supplementation.



Multiple sclerosis (MS)

- ▶ An **autoimmune disease**.
- ▶ **Affects:** **fasciculus cuneatus** of the **cervical spine**.
- ▶ **Leads to:** loss of proprioception in hands and fingers (**Astereognosis**).

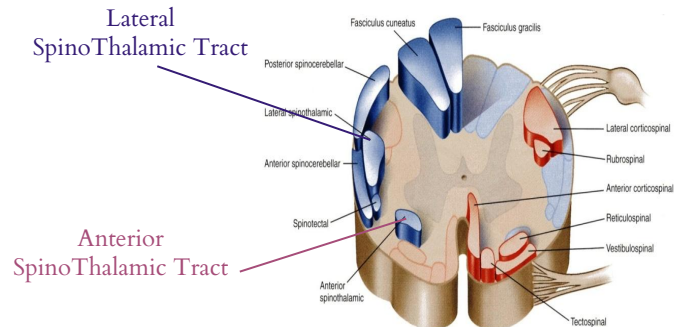
Symptoms:

- ▶ **Musculoskeletal:** Weakness, spasms, and ataxia.
- ▶ **Sensation:** Hypoesthesia, paraesthesia, and pain.

SpinoThalamic Tract

1 Anterior SpinoThalamic Tract

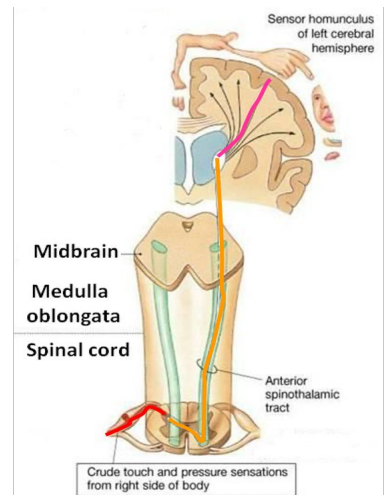
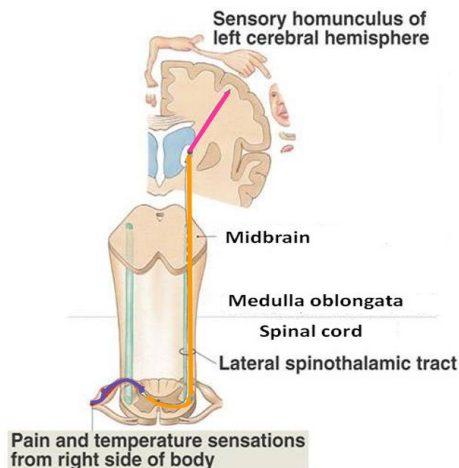
2 Lateral SpinoThalamic Tract



✦ In SpinoThalamic Tracts, the information is sent to the **primary sensory cortex** on the **contralateral** (opposite) side of the body.

	Lateral SpinoThalamic Tract	Anterior SpinoThalamic Tract
Location	Lateral to the ventral horn	Ventral to the ventral horn
Function	<ul style="list-style-type: none"> ▸ Pain ▸ Temperature sensation 	<ul style="list-style-type: none"> ▸ Crude touch (non-discriminative) ▸ Pressure
Arrangement of Fibers	<ul style="list-style-type: none"> ▸ (from lateral [superficial] to medial [deep]): Sacral → Lumbar → Thoracic → Cervical. ▸ So cervical is closer to the grey matter. 	
1st order neuron	Small cells in dorsal root ganglia.	Medium sized cells in dorsal root ganglia.
2nd order neuron	Cell body	Substantia gelatinosa of Rolandi in dorsal horn.
	Axon	Main sensory nucleus (nucleus proprius) in dorsal horn.
3rd order neuron	Fibers decussate in the anterior white commissure and ascent as spinal lemniscus .	
3rd order neuron	Cells of Ventral Posterior Nucleus of the Thalamus.	

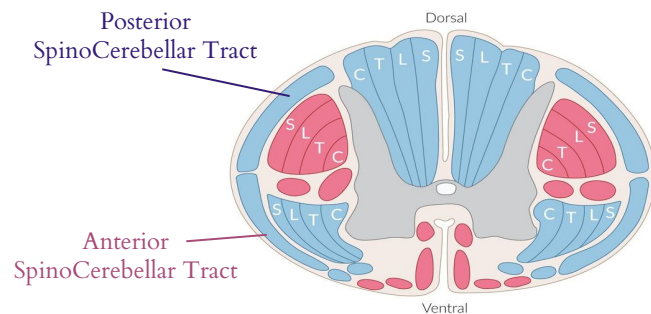
Picture



SpinoCerebellar Tract

1 Dorsal (Posterior) SpinoCerebellar Tract

2 Ventral (Anterior) SpinoCerebellar Tract



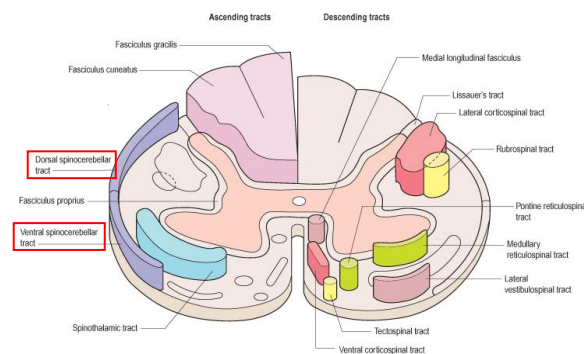
Consist of sequence of **two** neurons only

► Neuron 1:
Large cells of dorsal root ganglia.

► Neuron 2:
Cells of nucleus dorsalis; Clark's Column.

Function

- Carry information from muscle spindles, Golgi tendon organs and tactile receptors to the cerebellum.
- It is involved to control posture, balance and coordination of movement.
- **Convey** sensory information to the **same side** of the cerebellum.



Posterior SpinoCerebellar Tract

Anterior SpinoCerebellar Tract

Segment

Above L3

LumboSacral

1st order neuron

Large cells of dorsal root ganglia.

Cell body

Clark's column

Base of the dorsal horn

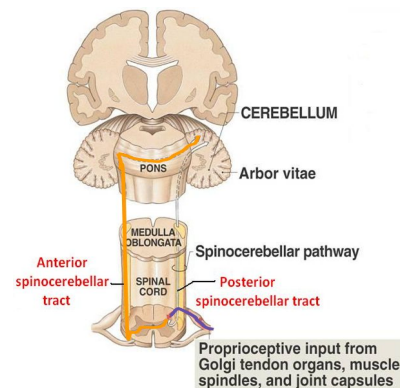
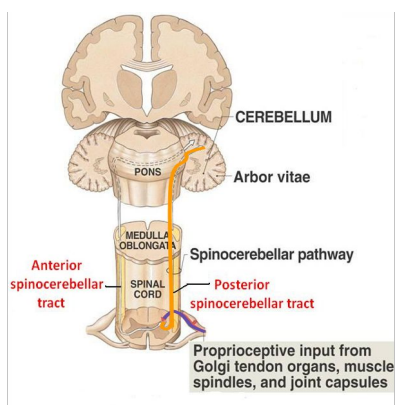
2nd order neuron

Axon

Terminate **ipsilaterally** (uncrossed) in the cerebellar cortex by entering through the **inferior cerebellar peduncle**.
(Does not cross at all)

Cross to **the opposite side**, ascend to enter the **superior cerebellar peduncle** then cross the midline for a **second** time within the **cerebellum** before terminating in the cerebral cortex.
(cross twice)

Picture



Applied Anatomy

Dorsal Column Lesions

SpinoThalamic Tract Lesions

SpinoCerebellar Tract Lesions

Syringomyelia

- ▶ The SpinoThalamic Tracts are selectively damaged in **syringomyelia**.
- ▶ The central canal become enlarged, forming a cavity compressing the adjacent nerve fibers in the **CervicoThoracic segment** of spinal cord.

- ▶ Fibers serving **pain and temperature** are damaged as they decussate in the ventral white commissure, close to the central canal.

- ▶ **Leads to:** **Selective loss of pain and temperature in the upper limbs** (dissociated sensory loss).

- ▶ Light touch and proprioceptive sensation are retained.

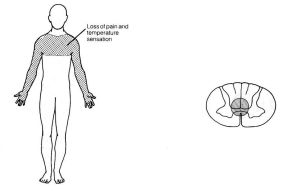


Figure 8-17. Syringomyelia involving the cervicothoracic portion of the spinal cord.

- ▶ Joints of the limbs become disorganized without discomfort (**Charcot's joint**), which is a **rare but serious complication**.



Dorsal Column Lesions

SpinoThalamic Tract Lesions

SpinoCerebellar Tract Lesions

Friedreich's Ataxia

- ▶ An inherited degenerative disease affecting the SpinoCerebellar Tracts.

- ▶ **Leads to:** Ipsilateral loss of muscle coordination, as incoordination of arms, intense tremor, impaired muscle coordination (**gait ataxia**).

- ▶ It begins in childhood.

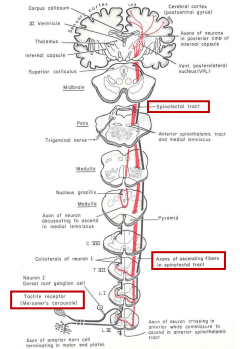
- ▶ Wheelchair is bound by 20 years of age.

Other Tracts

1. SpinoTectal Tract

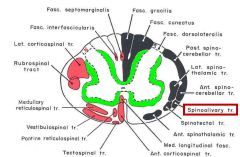
- Ascends in the **anterolateral** part, in close association with SpinoThalamic system.
- **Function:** It is involved in reflexive turning of the **head and eyes** toward a point of **cutaneous stimulation**.

- **1st order neuron:**
 - Dorsal root ganglion.
- **2nd order neuron:**
 - Cell body: Base of the dorsal horn.
 - Axons: Cross to opposite side, and project to the **periaqueductal gray matter and superior colliculus in the midbrain**.



2. Spino-Olivary Tract

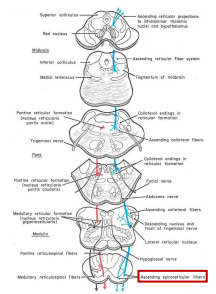
- It is an indirect SpinoCerebellar Pathway (Spino-Olivo-Cerebellar).
- Impulses from the spinal cord (Spino-Olivary Tract) are relayed to the cerebellum **via inferior olivary nucleus in medulla oblongata**.



- **Function:** Contribute to movement coordination associated primarily with balance.

3. SpinoReticular Tract

- Originates in the dorsal horn, and ascend in the **ventrolateral region of the cord**.
- Contains uncrossed fibers that end in **medullary reticular formation**.
- Crossed & uncrossed fibers that terminate in **pontine reticular formation**, then to **midbrain reticular formation** finally to the **thalamus**; that activate the **cerebral cortex** via the **ascending reticular activating system**.



- **Function:** It is involved in perception of dull aching (mild slow pain) as slight headache, sore muscle.

Team Leaders

Remaz Almahmoud

Moath Alhudaif

Areej Alquraini

Faris Alzahrani

Sarah Alshahrani

Team Members

Aleen Alkulyah

Ghaida Aldossary

Omar Almogren

Khawla Alfaqih


Retal alshohail

Nazmi M Alqutub


Haya Alajmi

Norah Almania

Abdulaziz Alqarni

 Sarah Alajaji

Sara Alsharani

 Mansour Alotaibi

Almas Almutairi

Deena Almahawas

Khalid Alsobe

Bayan Alenazi

Khalid Alanezi

Sadeem Alyahya

Almuthana Alageel

Zahra Alhazmi

Aban Basfar

Salma Alsaadoun

Zeyad Alotaibi

Norah Almohaimeed

Mohammed Alqutub

Waad Alanazi

Abdalmalik Alshammakhi

Aseel Alshehri

Hamad Alyahya

Lama Alsuliman

Mohammed Alsalamah

Aljoharah Alkhalifah

Khalid Alsobei

Aishah Boureggah

Mohammed Alarfaj

Maryam Alghannam

Ziyad Alsalamah

Lama Alotaibi

Faisal Alshowier

Wafa Alakeel

Faisal Alhejji

Abdullah Aldhuwaihy

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Anatomy.med443@gmail.com