Neuroanatomy: Pain & Temperature

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Major Objectives

1. Discuss -- what is “pain?”
2. Outline the Anterolateral Quadrant (ALQ) pathway
3. Locate each of the four neurons in the ALQ pathway
4. Identify the level of decussation for the ALQ pathway

What is “pain”?

- Pain is whatever the experiencing person say it is, and exists whenever they say it does.

- An unpleasant sensory and emotional experience in association with actual or potential tissue damage, or described in terms of such damage.

ALQ Pathway

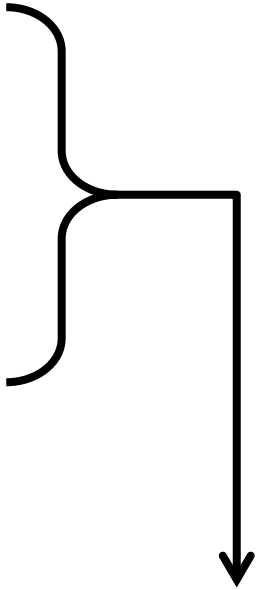
- Peripheral nerves
- Lissauer tract
- 1°→2° neurons in the dorsal horn
- ~~Anterior white commissure~~
- ALQ tract
- 2°→3° neurons in the VPL thalamus
- Post. limb of the internal capsule
- 3°→primary somatosensory cortex

Crosses Midline

Periphery & Spinal Cord

Peripheral nerve

- Nociceptors (free nerve endings)
  - Mechanical
  - Thermal
  - Chemical
  - Polymodal



Spinal cord
via dorsal root

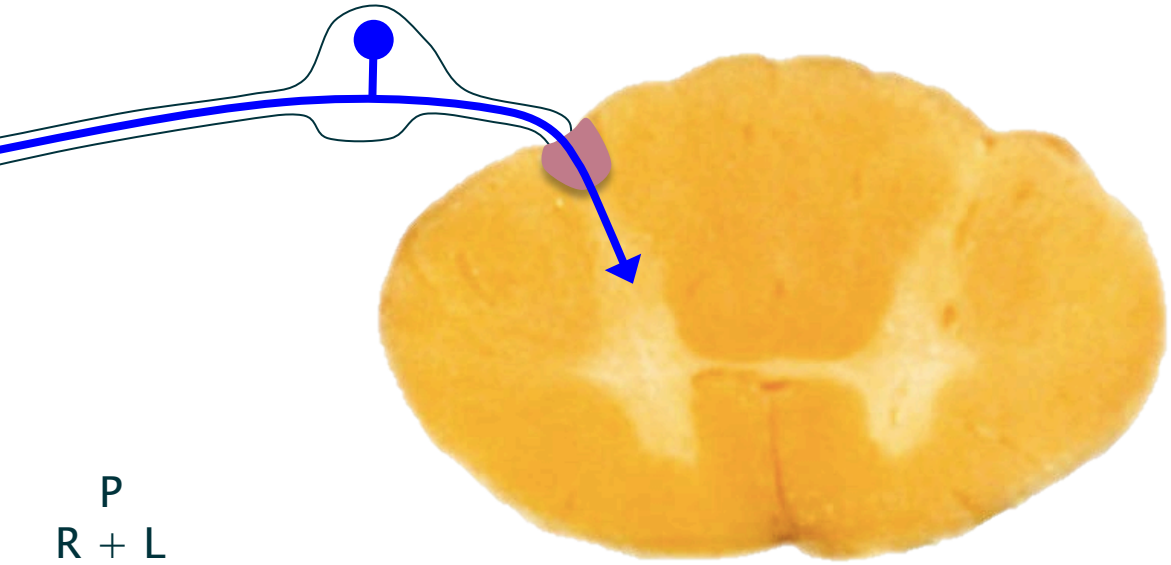
Periphery & Spinal Cord

Peripheral nerve

Cell bodies in dorsal root ganglia

- Pseudounipolar neurons ()
- Lissauer tract

1° axons synapse in dorsal horn

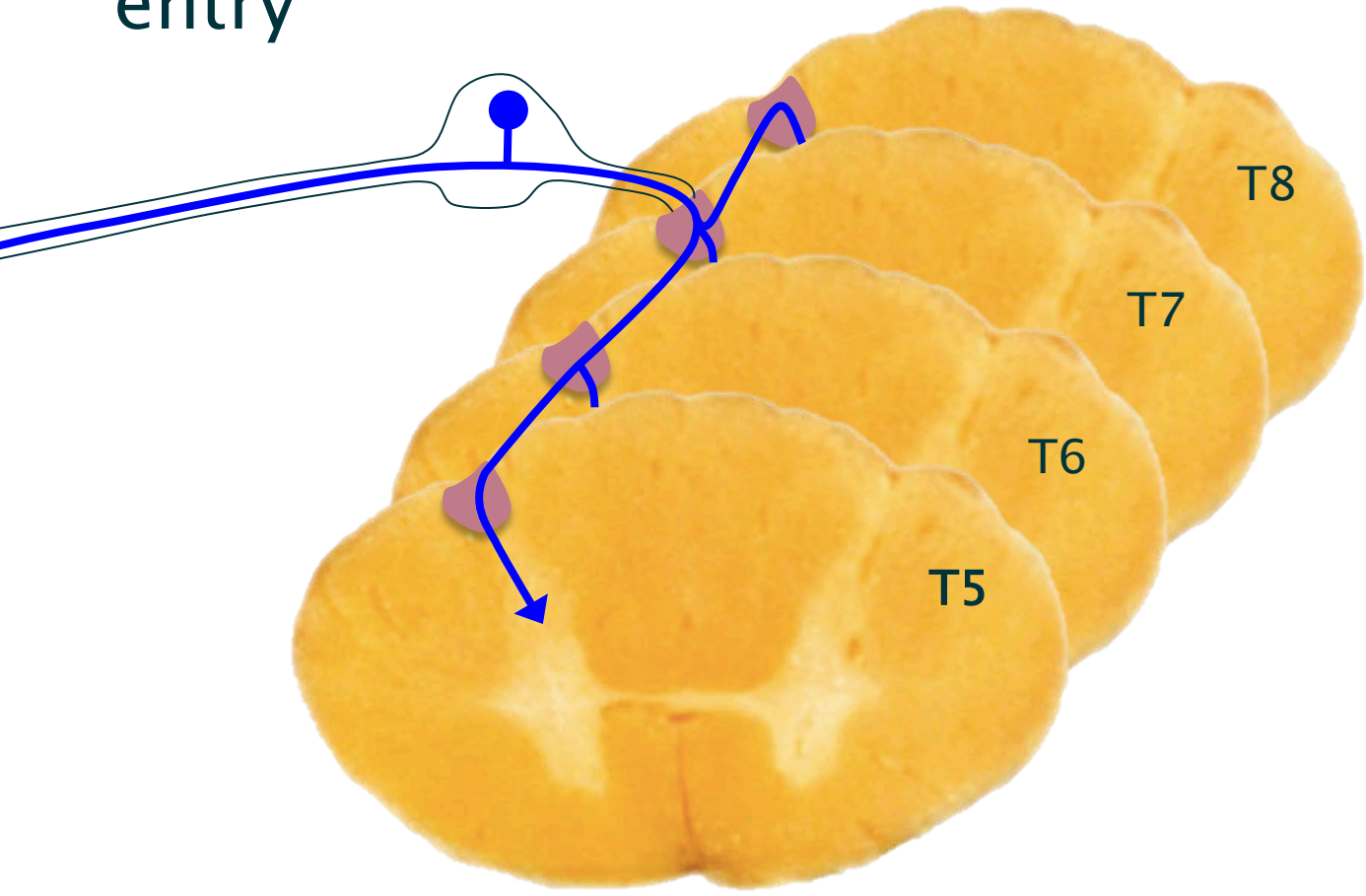


P
R + L
A

Periphery & Spinal Cord

Lissauer tract

- Pain and temperature neurons → can traverse 1–2 segments (as collaterals) or synapse at level of entry



Periphery & Spinal Cord

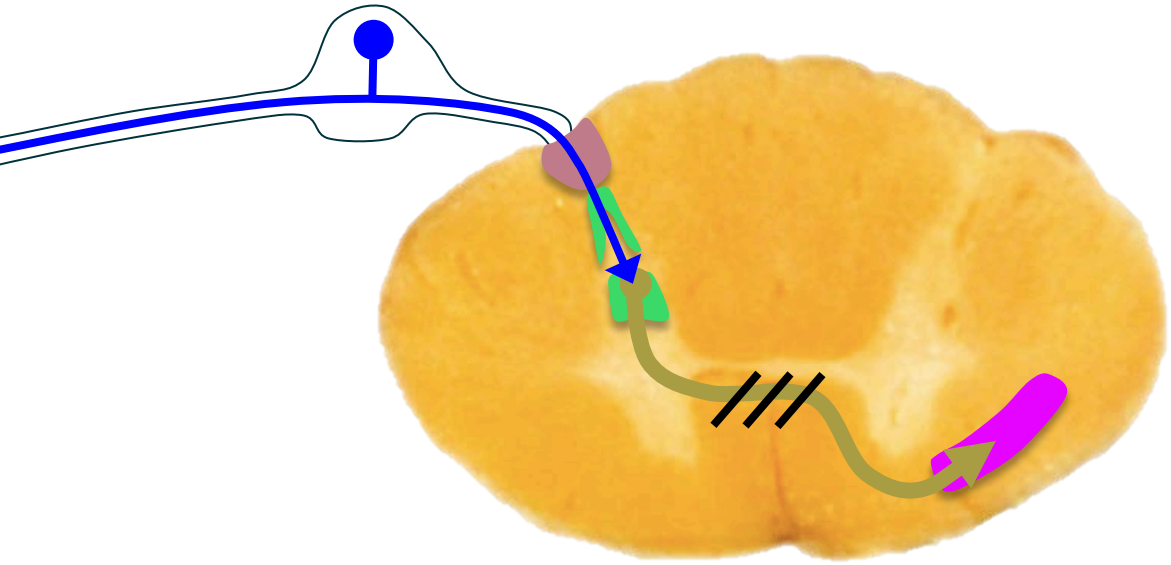
Dorsal horn

1° axons synapse in dorsal horn

Marginal zone and/or N. proprius

2° axons gradually cross (///) in anterior white commissure

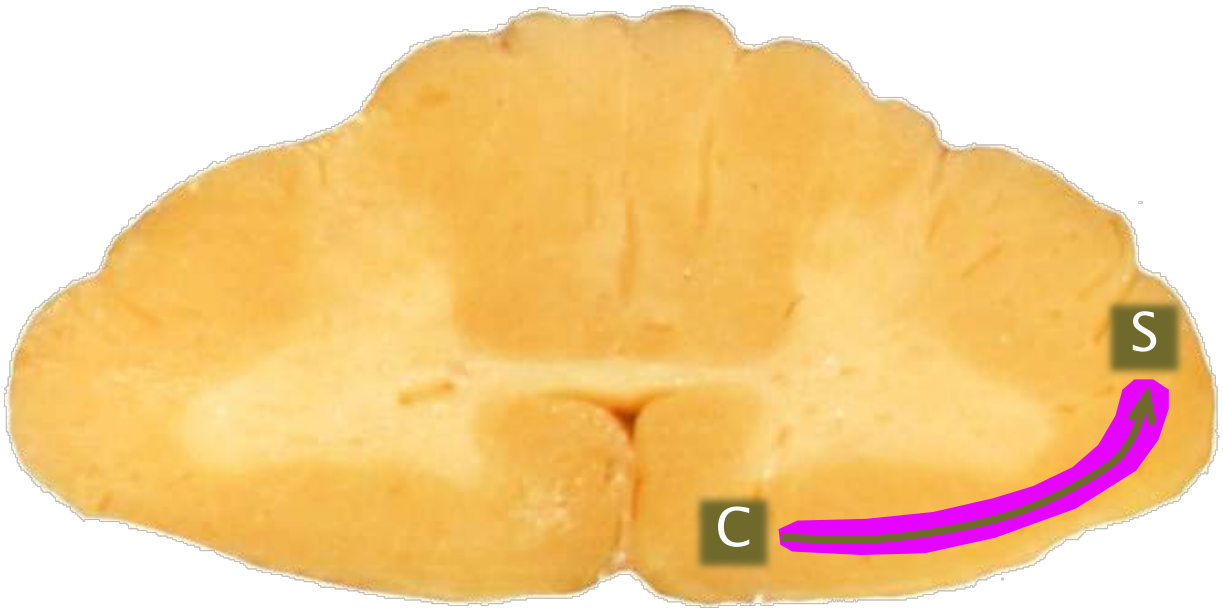
ALQ tract

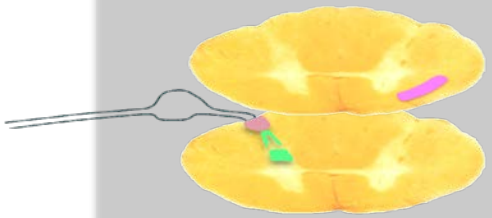


Spinal cord

Cervical region

- ALQ tract
- Somatotopic organization (C→S)

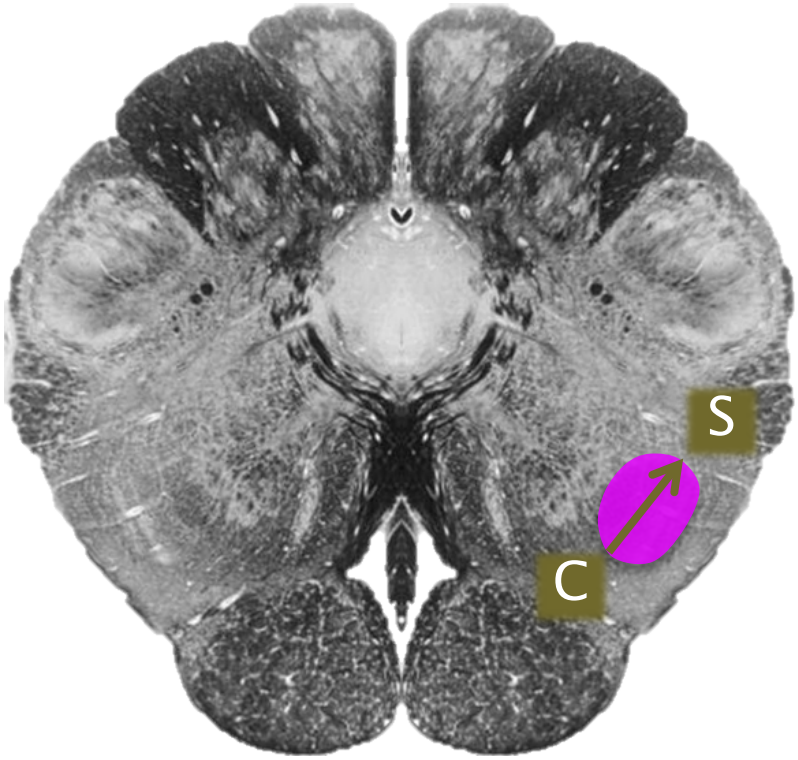


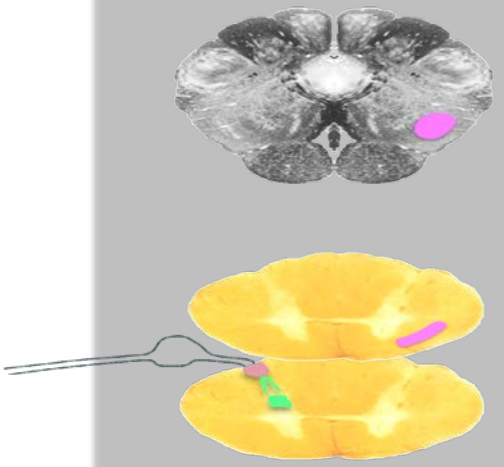


Brainstem

Caudal medulla

- ALQ tract
- Somatotopic organization (C→S)

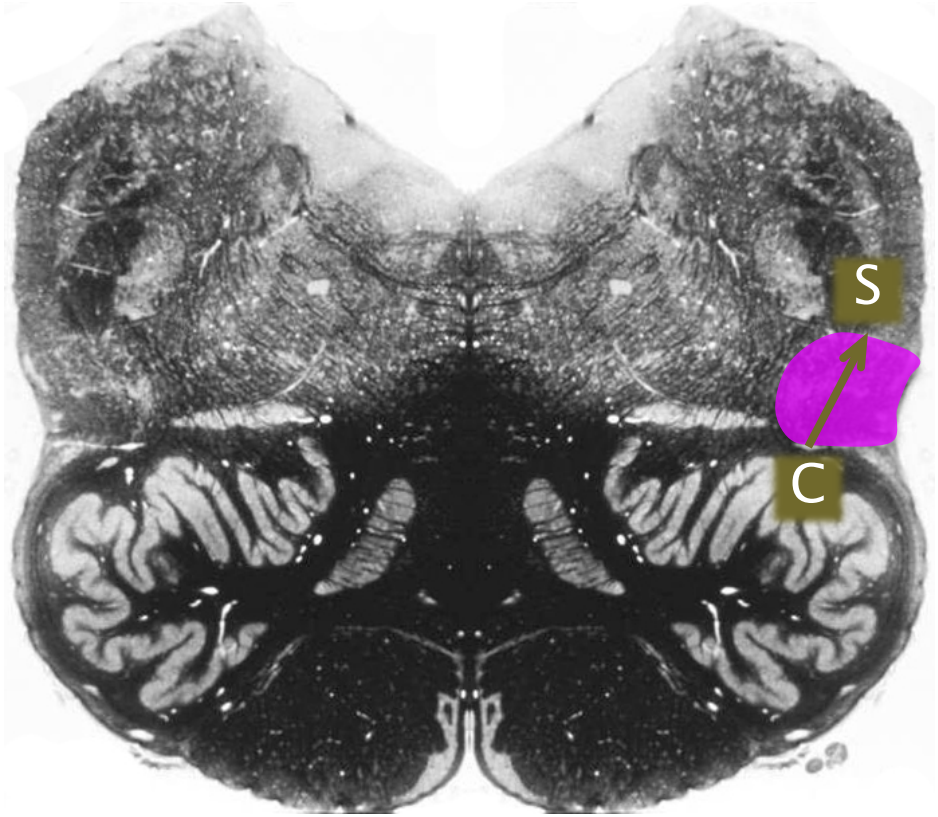


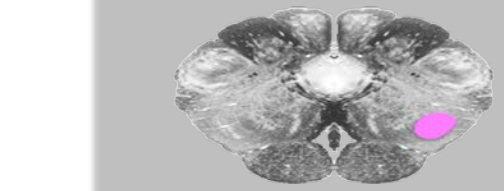


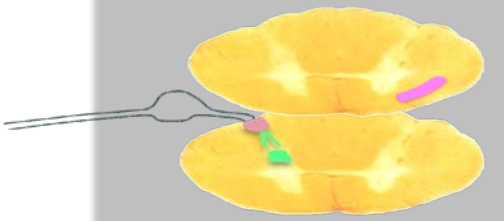
Brainstem

Rostral medulla

- ALQ tract
- Somatotopic organization (C→S)



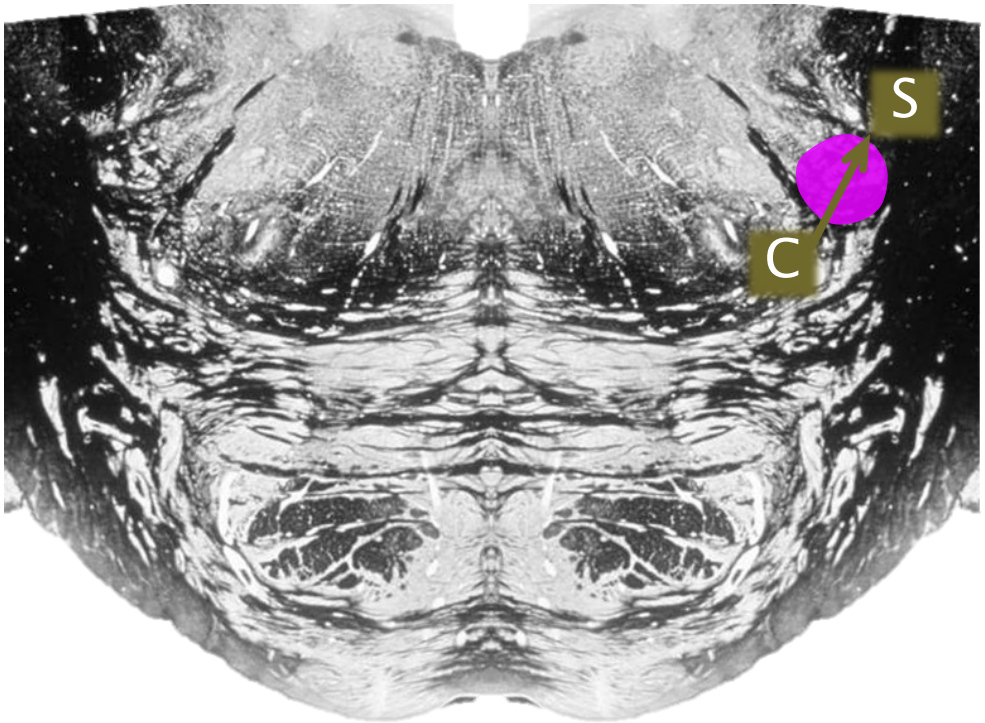


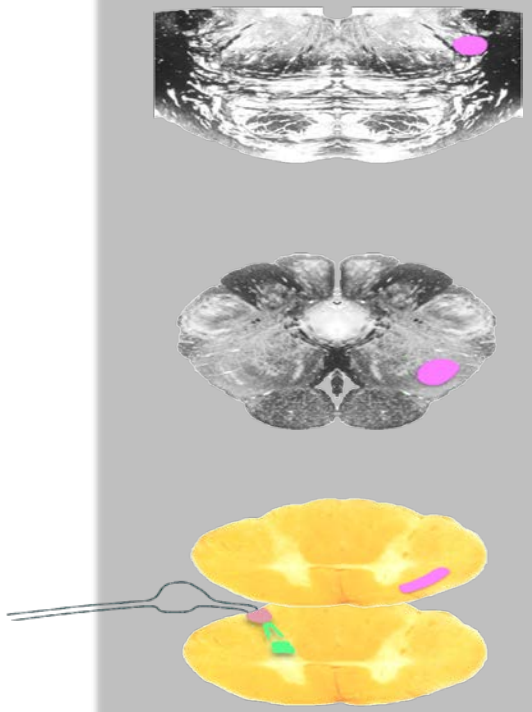


Brainstem

Caudal pons

- ALQ tract
- Somatotopic organization (C→S)

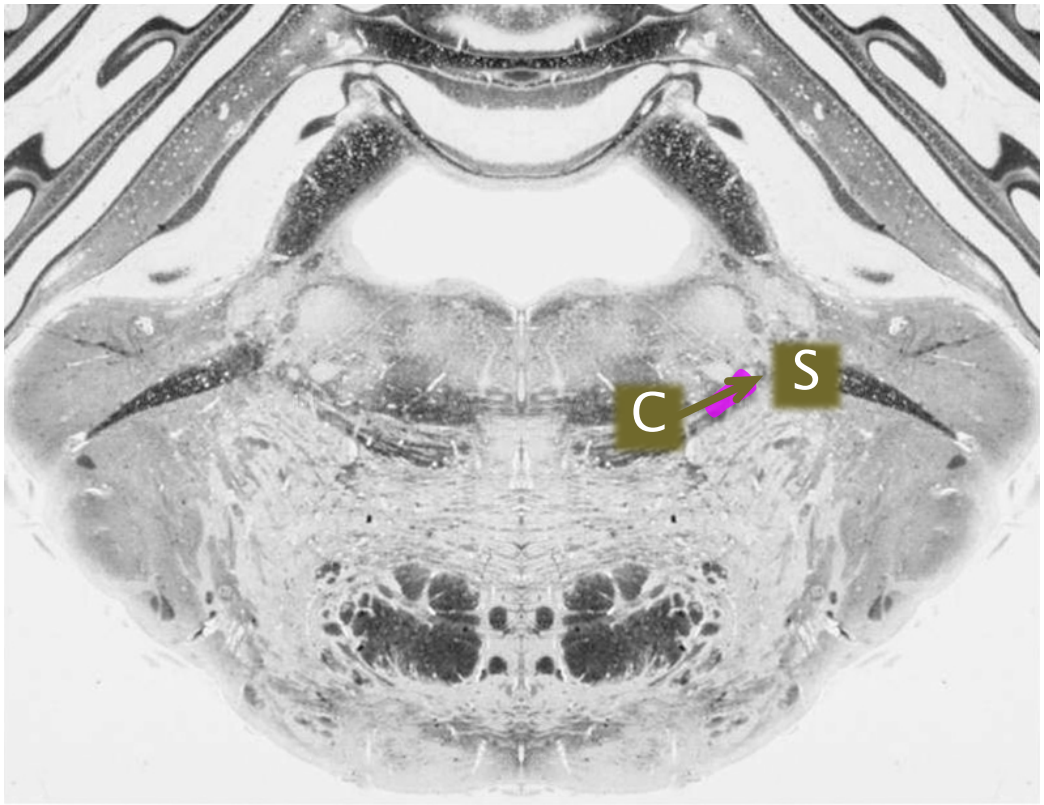


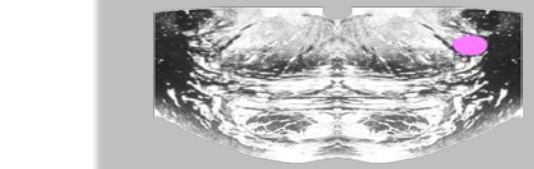


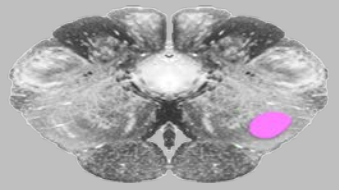
Brainstem

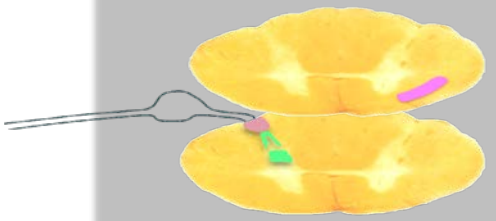
Middle pons

- ALQ tract
- Somatotopic organization (C→S)





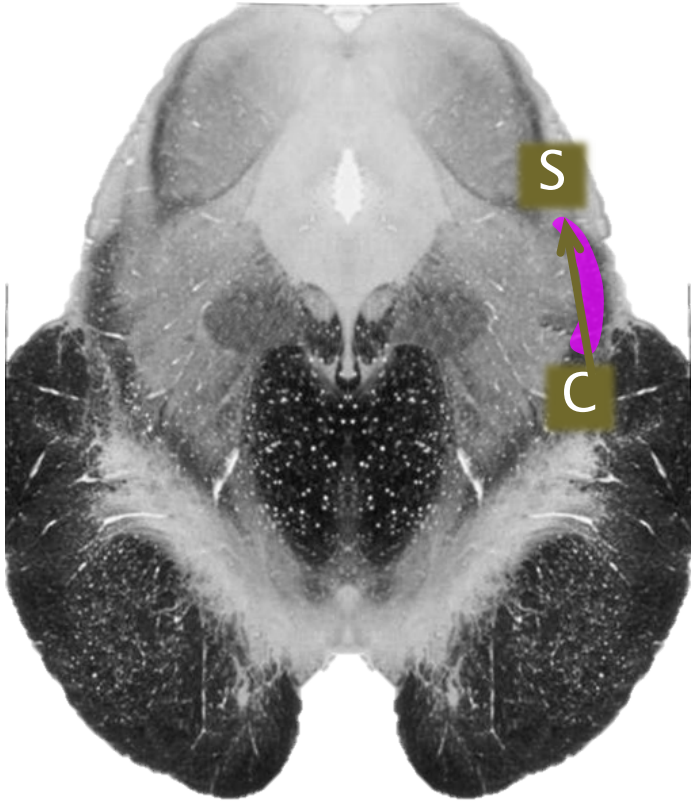


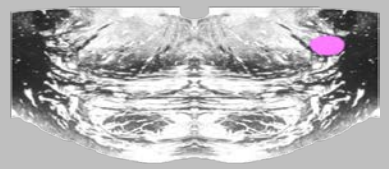


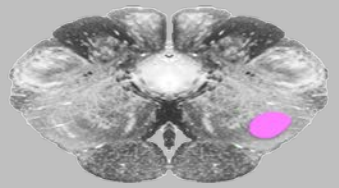
Brainstem

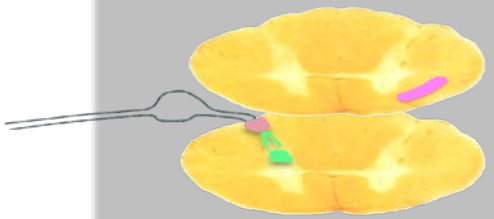
Caudal midbrain

- ALQ tract
- Somatotopic organization (C→S)





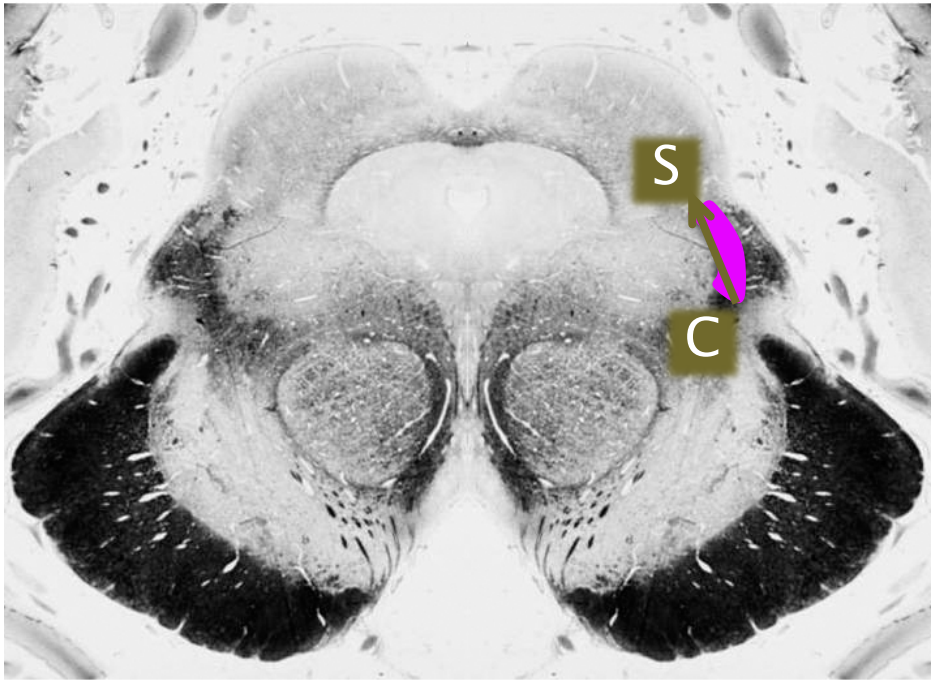


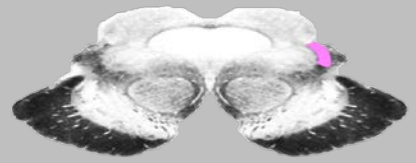


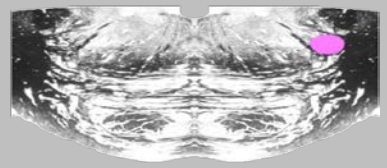
Brainstem

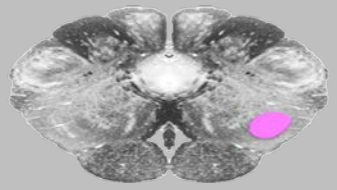
Rostral midbrain

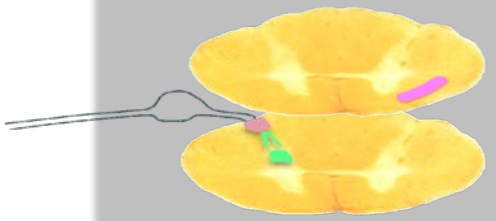
- ALQ tract
- Somatotopic organization (C→S)





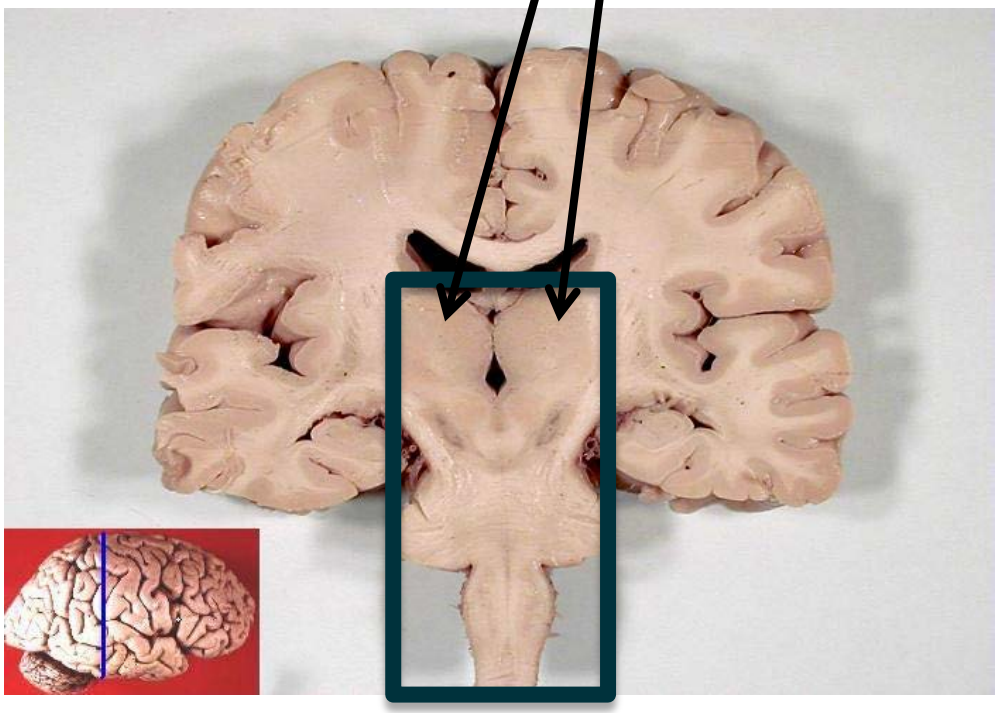






Diencephalon

Thalamus



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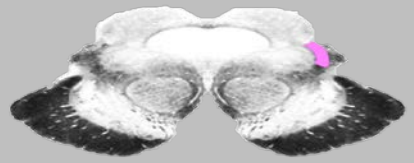
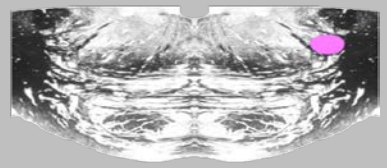
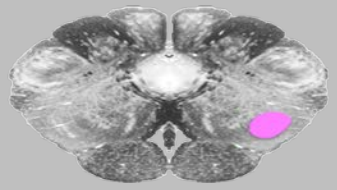
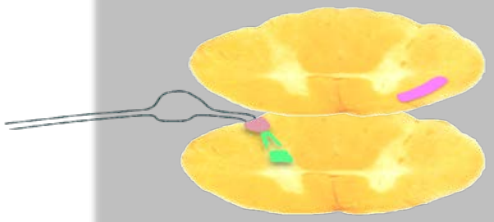








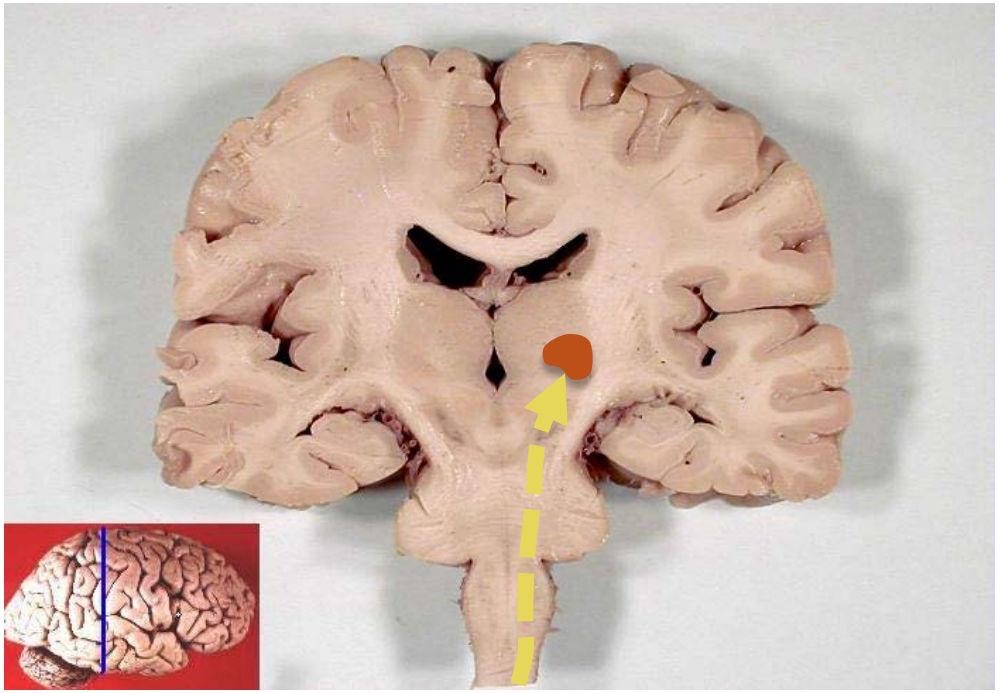
Diencephalon

Thalamus

- Ventral Posterolateral (VPL) nucleus

2° axons synapse in VPL

- Somatotopic organization (C→S)



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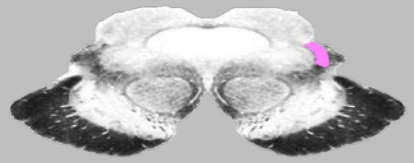
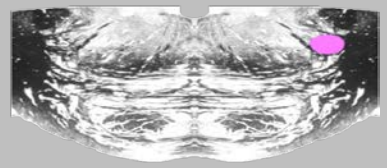
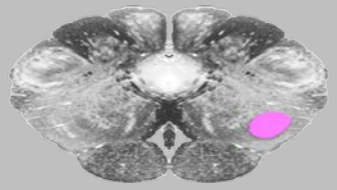
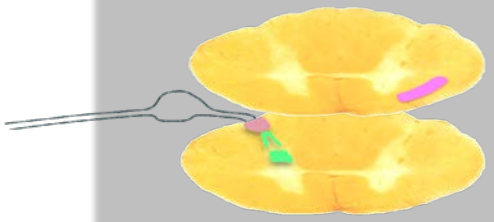








Diencephalon

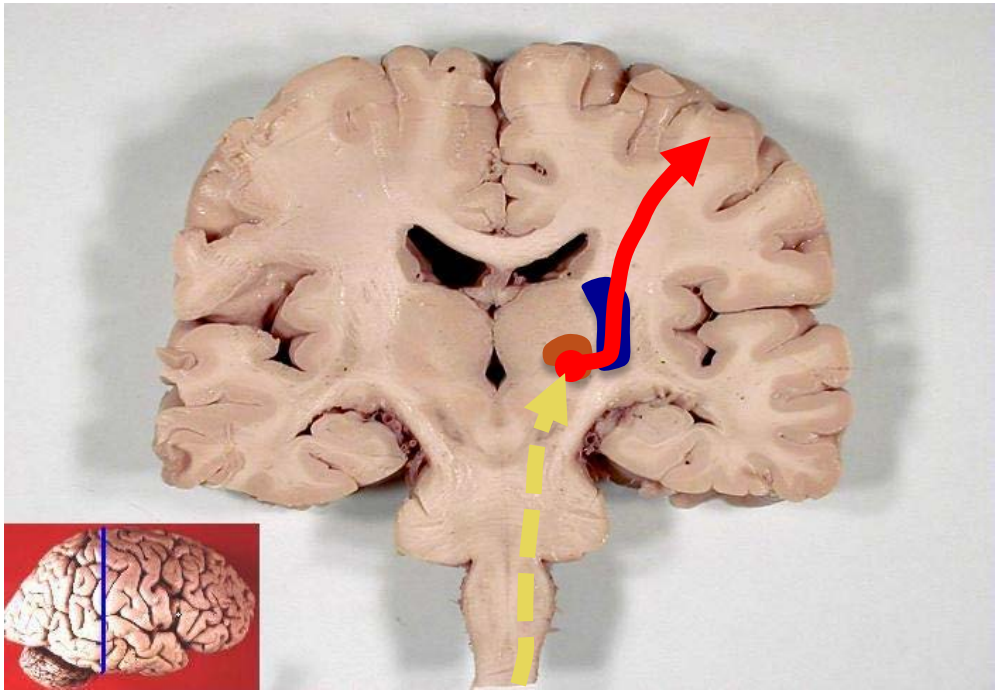
Thalamus

- Ventral Posterolateral (VPL) nucleus

Internal capsule

- Posterior limb

3° axons exit VPL thalamus



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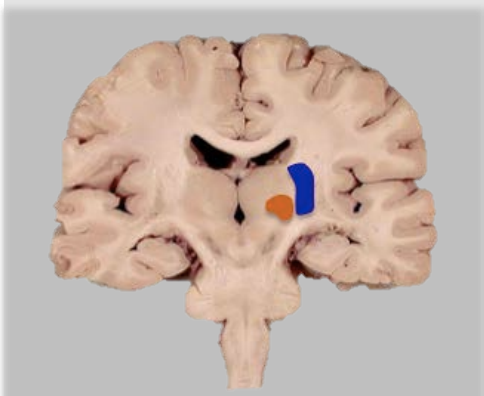

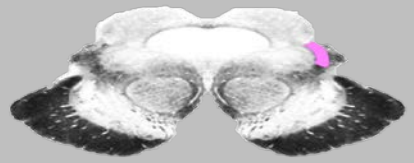

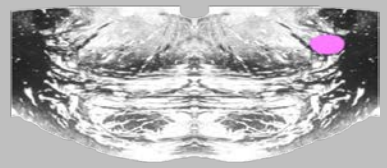

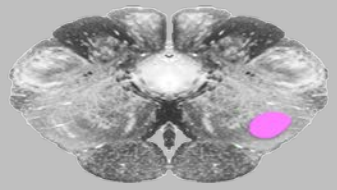

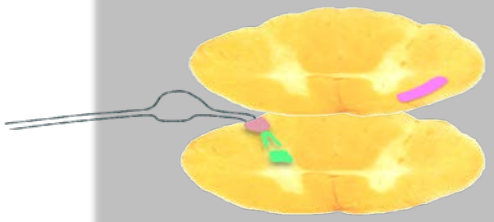

Diencephalon

Thalamus

- Ventral Posterolateral (VPL) nucleus

Internal capsule

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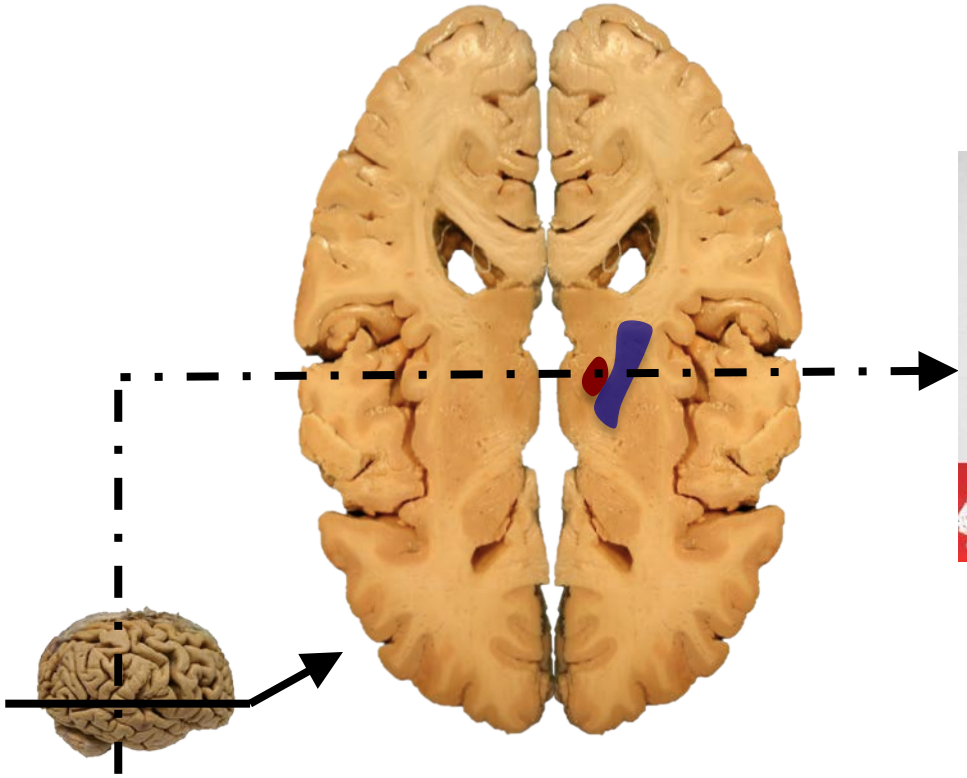
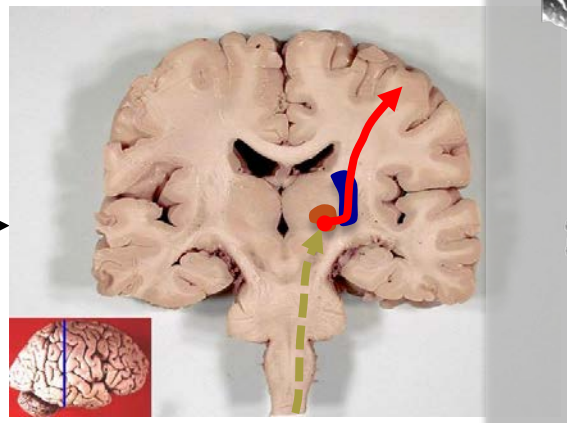
3° axons exit VPL thalamus





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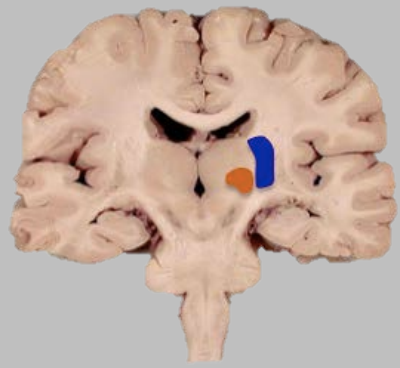
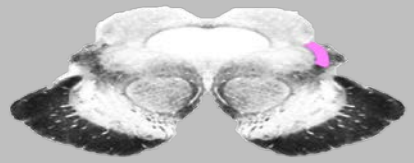
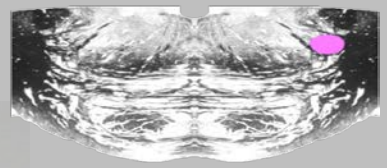
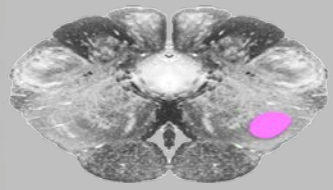
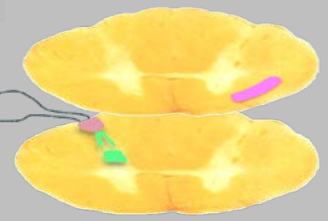




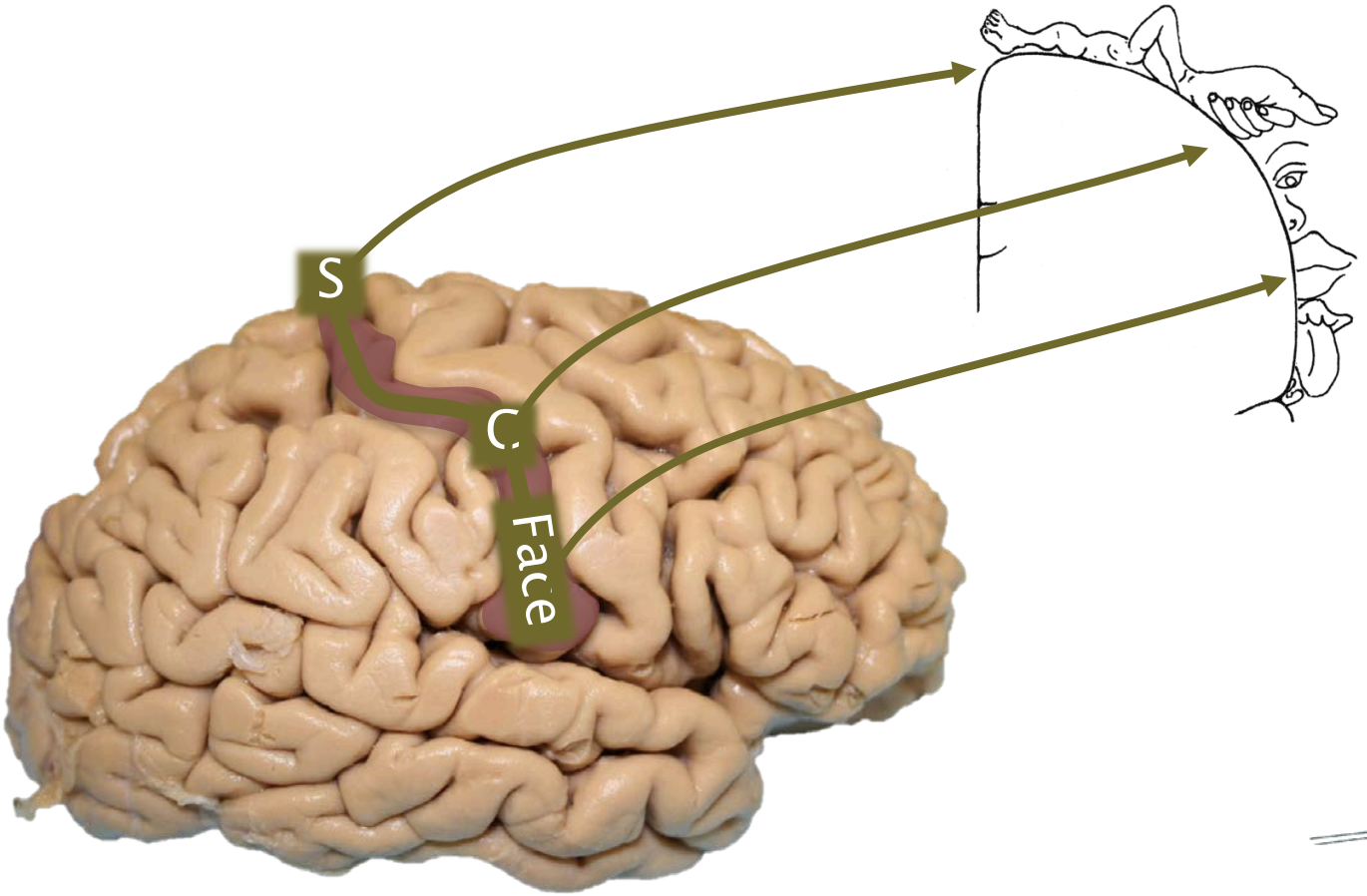


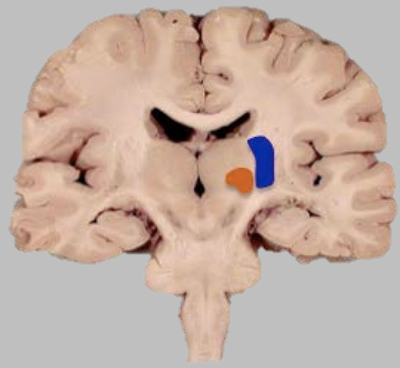


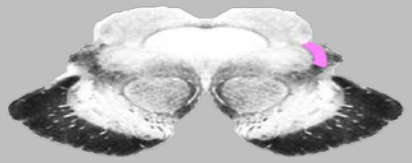


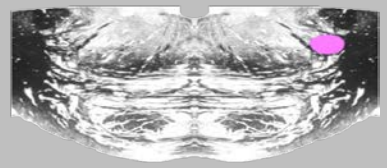
Forebrain

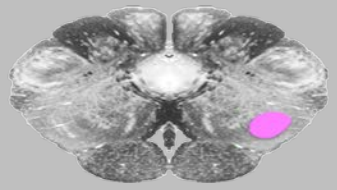
- Postcentral gyrus
- Somatotopic organization (homunculus Face+C→S)

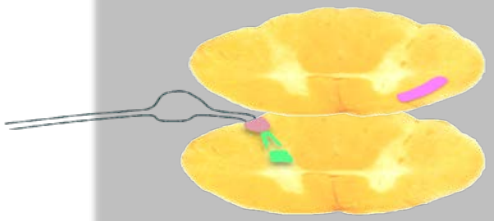






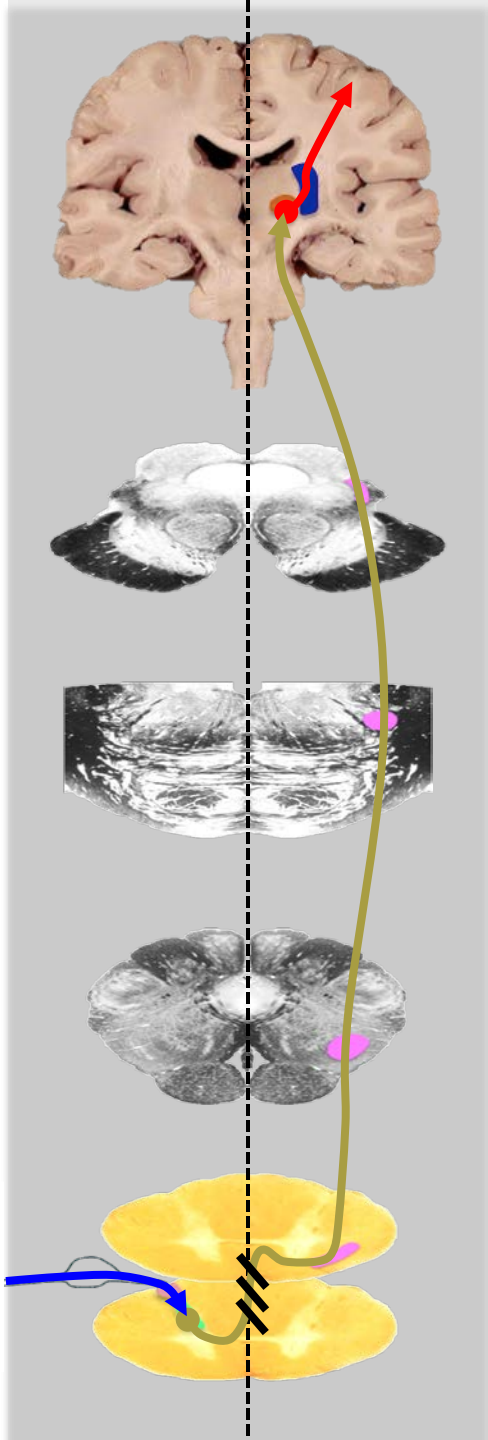






ALQ Review

- Peripheral nerves
- Lissauer tract
- 1°→2° neurons in the dorsal horn
- Anterior white commissure
- ALQ tract
- 2°→3° neurons in the VPL thalamus
- Post. limb of the internal capsule
- 3°→primary somatosensory cort



Pearls & Problems

Don't	✓ Try to learn all the details on your first pass.
Do	✓ Compare and contrast the ALQ pathway with other sensory pathways. Where do they cross?
Don't	✓ Limit yourself to the perspective's we've shown, neuroanatomical features may be seen best in different orientations.
Do	✓ Once you have the tract locations down and the decussation makes sense, add the somatotopic "fluff" details.