Muscle Tone

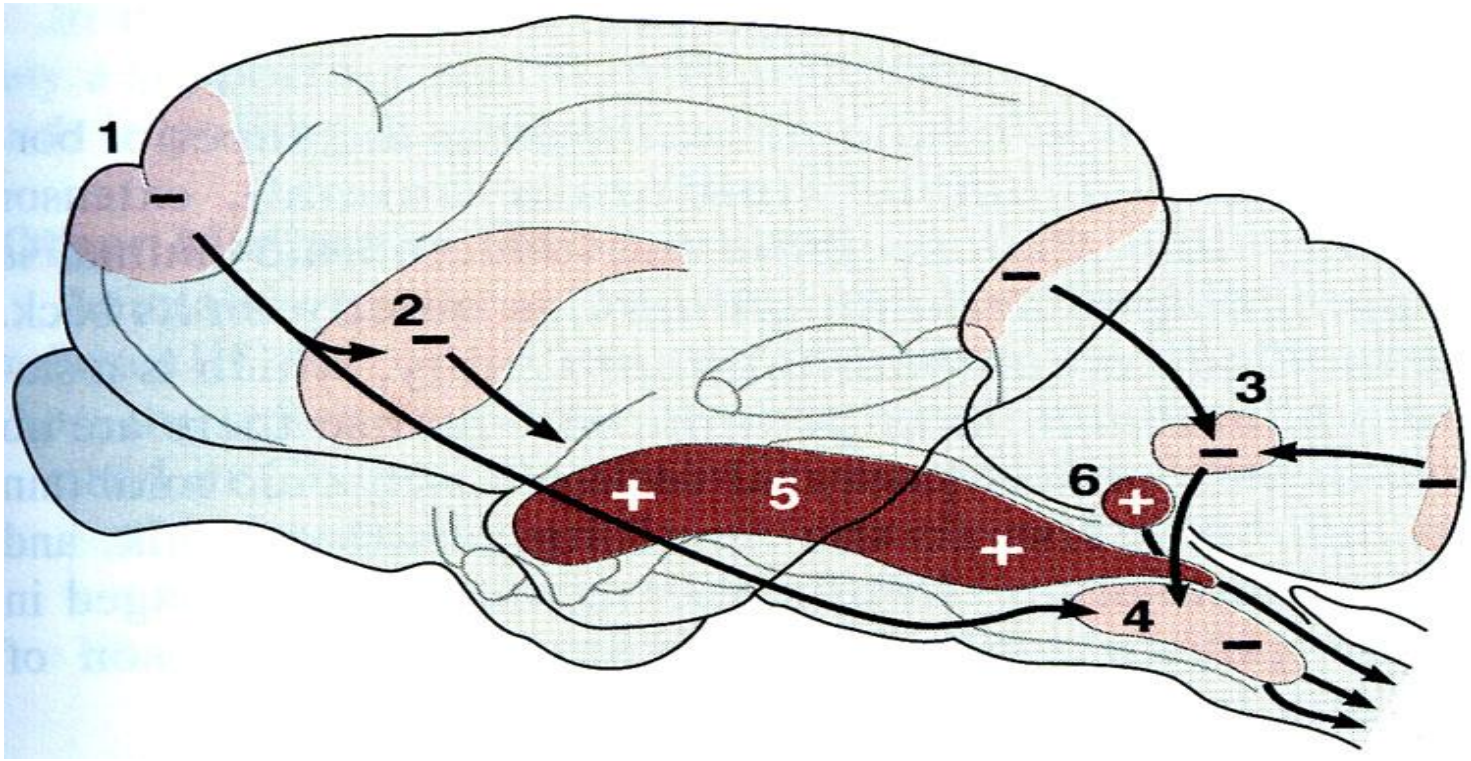
Muscle tone is the continuous and passive partial contraction of the muscles, or the muscle's resistance to passive stretch during resting state.

-Present in antigravity muscle (extensors of LL, back, neck, flexor of UL, muscle of abdominal wall and elevator of mandible

-if lost >>>>>hypotonic or flaccidity

-if increased >>>>>>hypertonic, spastic muscle

Supra spinal centers: Facilitated and inhibitory area



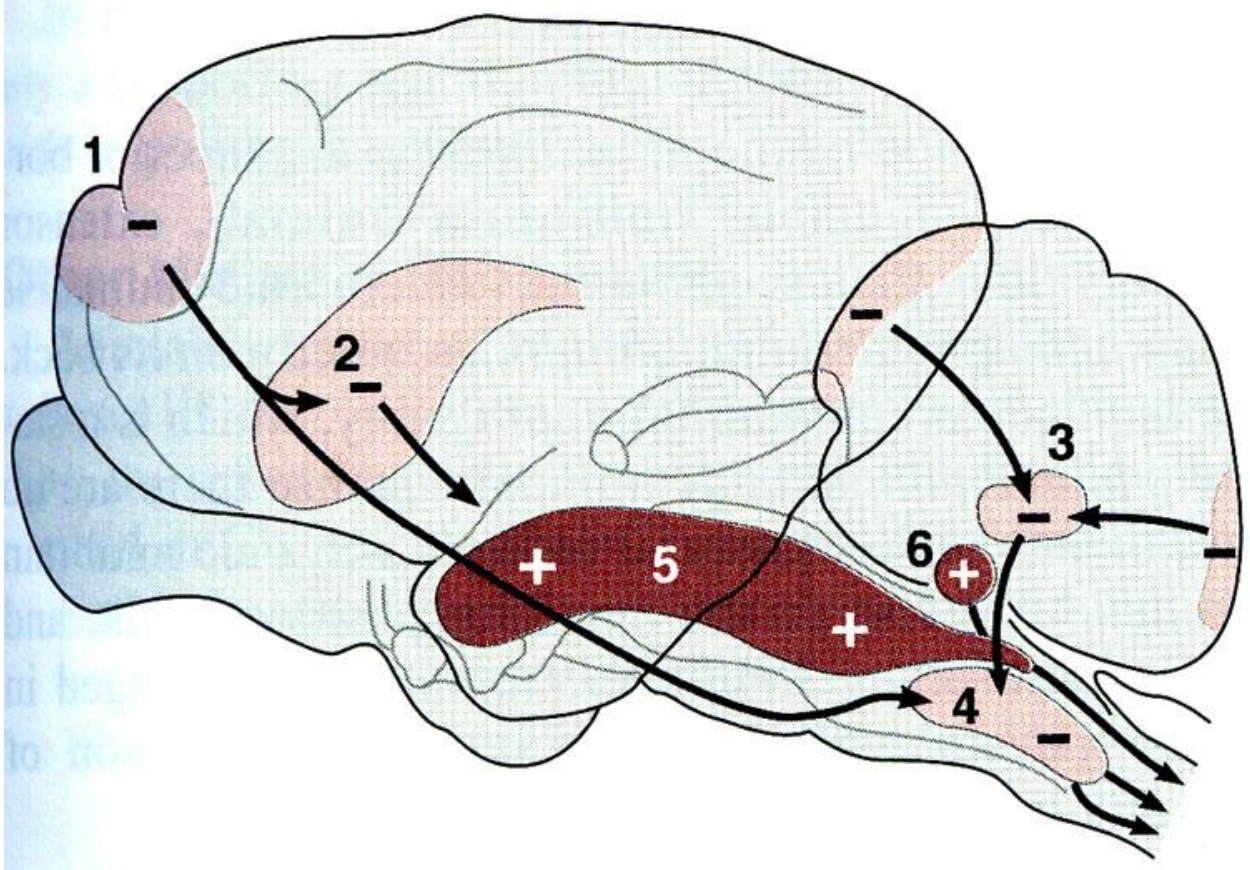
Areas in the cat brain where stimulation produces facilitation (+) or inhibition (-) of **stretch reflexes**. 1. motor cortex; 2. Basal ganglia; 3. Cerebellum; 4. Reticular inhibitory area; 5. Reticular facilitated area; 6. Vestibular nuclei.

1. Facilitated area—roles of the reticular and vestibular nuclei.:

(1) The pontine reticular nuclei

- Located slightly posteriorly and laterally in the pons and extending to the mesencephalon,
- Transmit excitatory signals downward into the cord (the pontine reticulospinal tract)

1. motor cortex;
2. Basal ganglia;
3. Cerebellum;
4. Reticular inhibitory area;
5. Reticular facilitated area;
6. Vestibular nuclei.



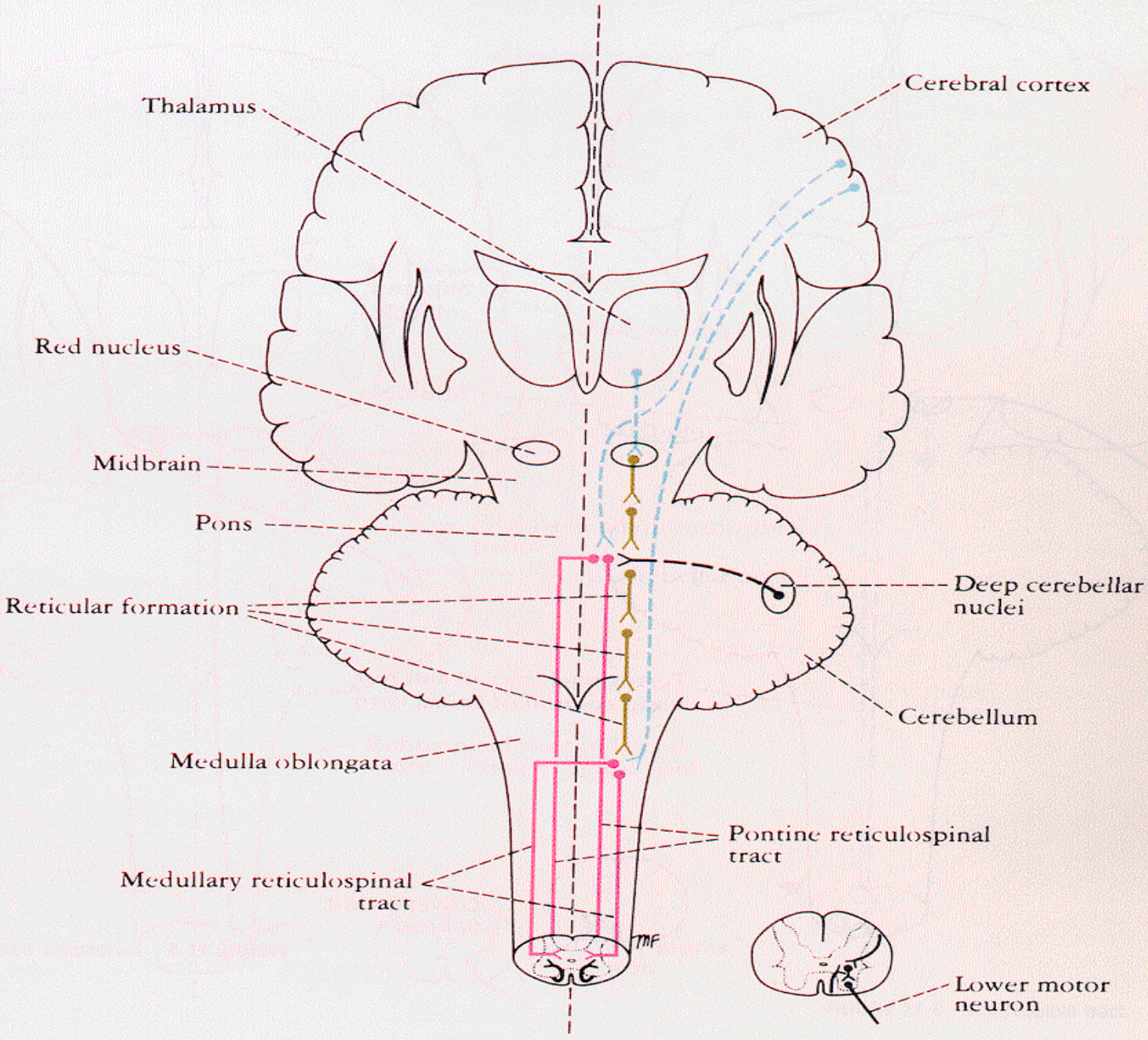
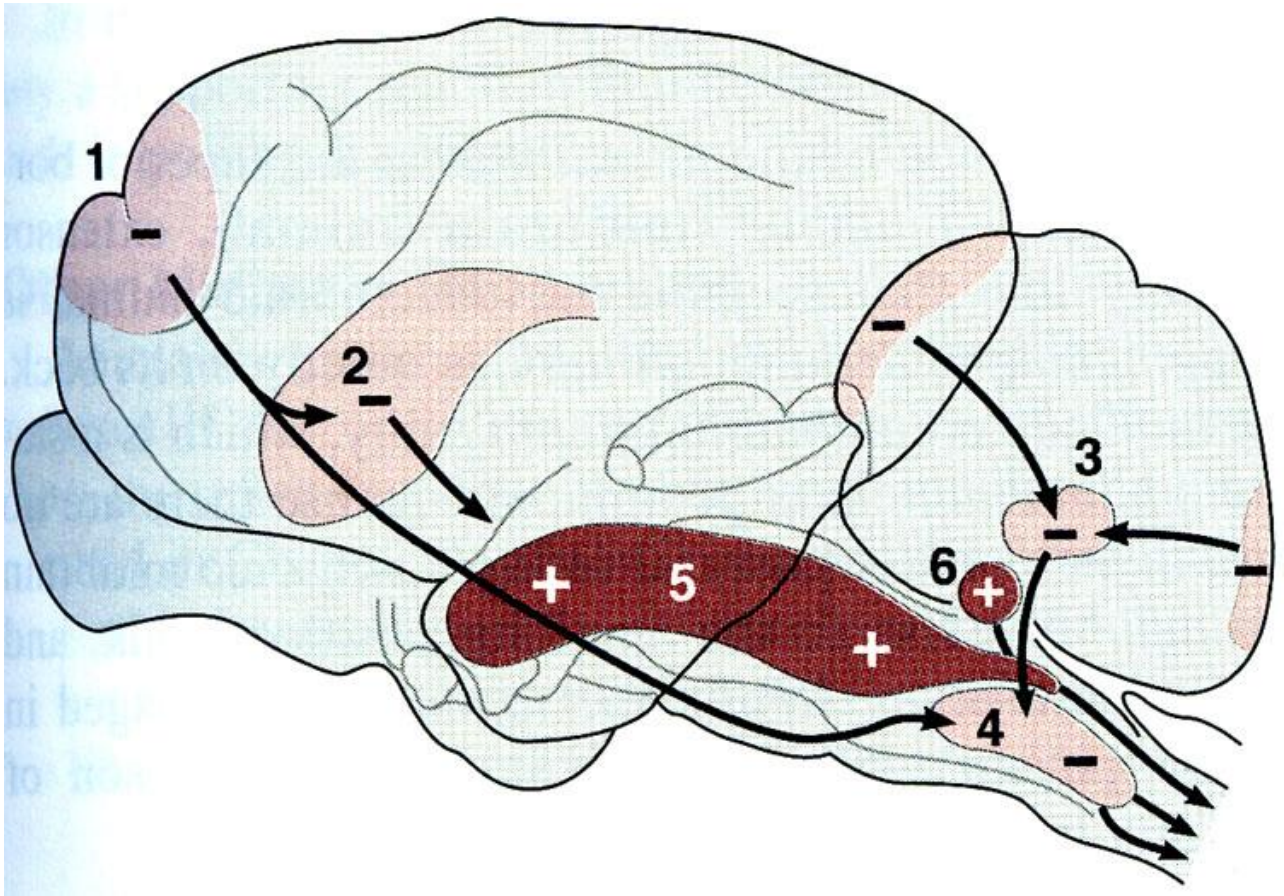


FIGURE 21-4 Reticulospinal tracts.

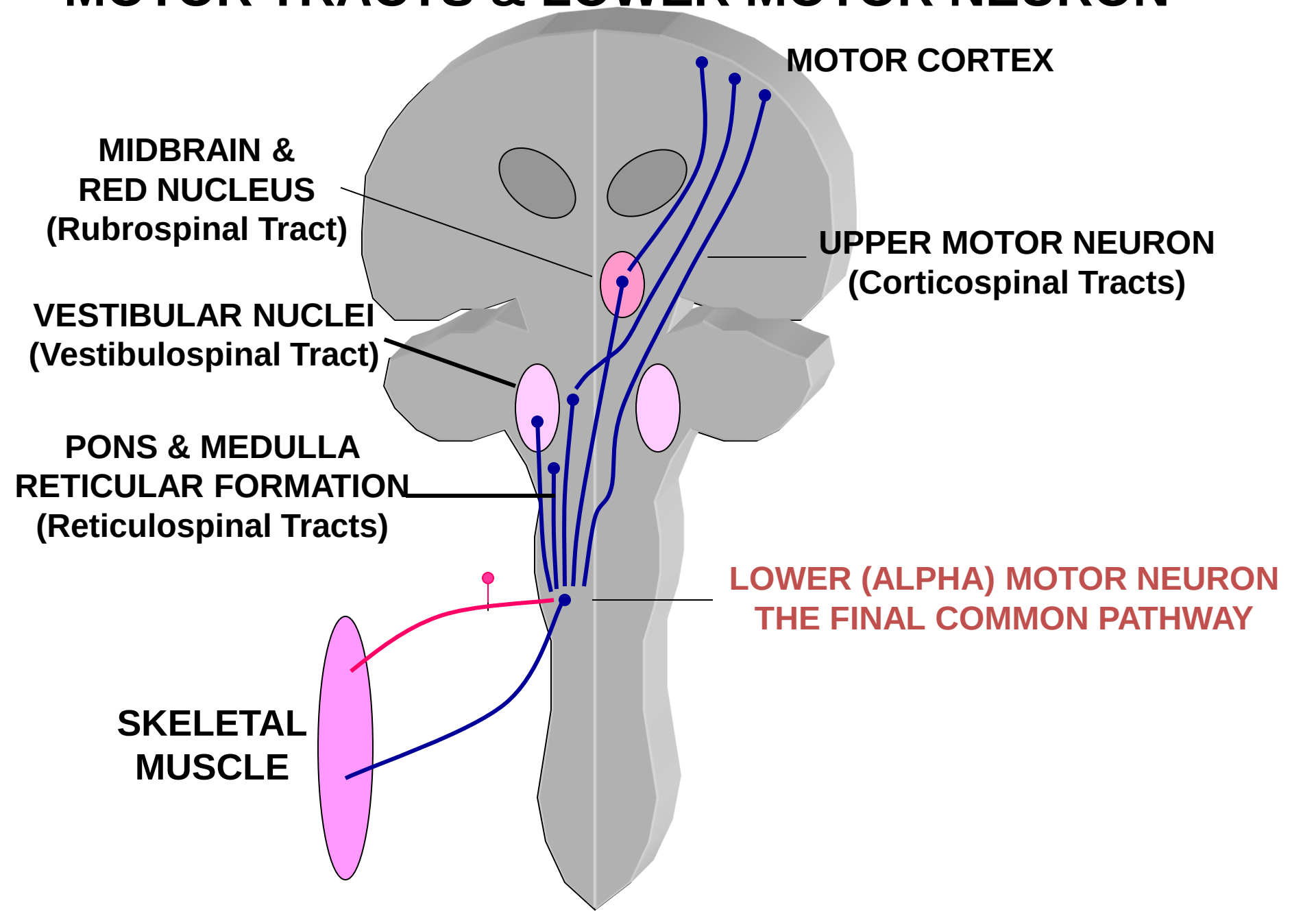
(2) The vestibular nuclei

• selectively control the excitatory signals to the different antigravity M. to maintain equilibrium in response to signals from the vestibular apparatus.

1. motor cortex;
2. Basal ganglia;
3. Cerebellum;
4. Reticular inhibitory area;
5. Reticular facilitated area;
6. Vestibular nuclei.



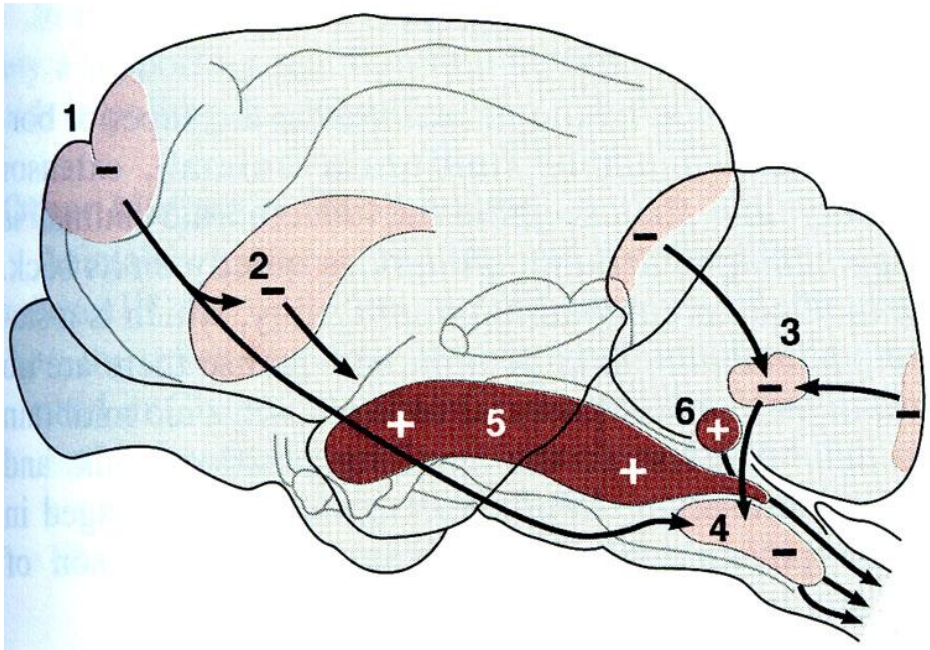
MOTOR TRACTS & LOWER MOTOR NEURON



Properties of the Facilitated Area

- Terminate on the motor neurons that exciting antigravity M. of the body (the M. of vertebral column and the extensor M. of the limbs).
- Have a high degree of **natural (spontaneous) excitability**.
- Receive especially strong excitatory signals from vestibular nuclei and the deep nuclei of the cerebellum.
- Cause powerful excitation of the antigravity M throughout the body (facilitate a standing position), supporting the body against gravity.

1. motor cortex; 2. Basal ganglia; 3. Cerebellum; 4. Reticular inhibitory area; 5. Reticular facilitated area; 6. Vestibular nuclei.

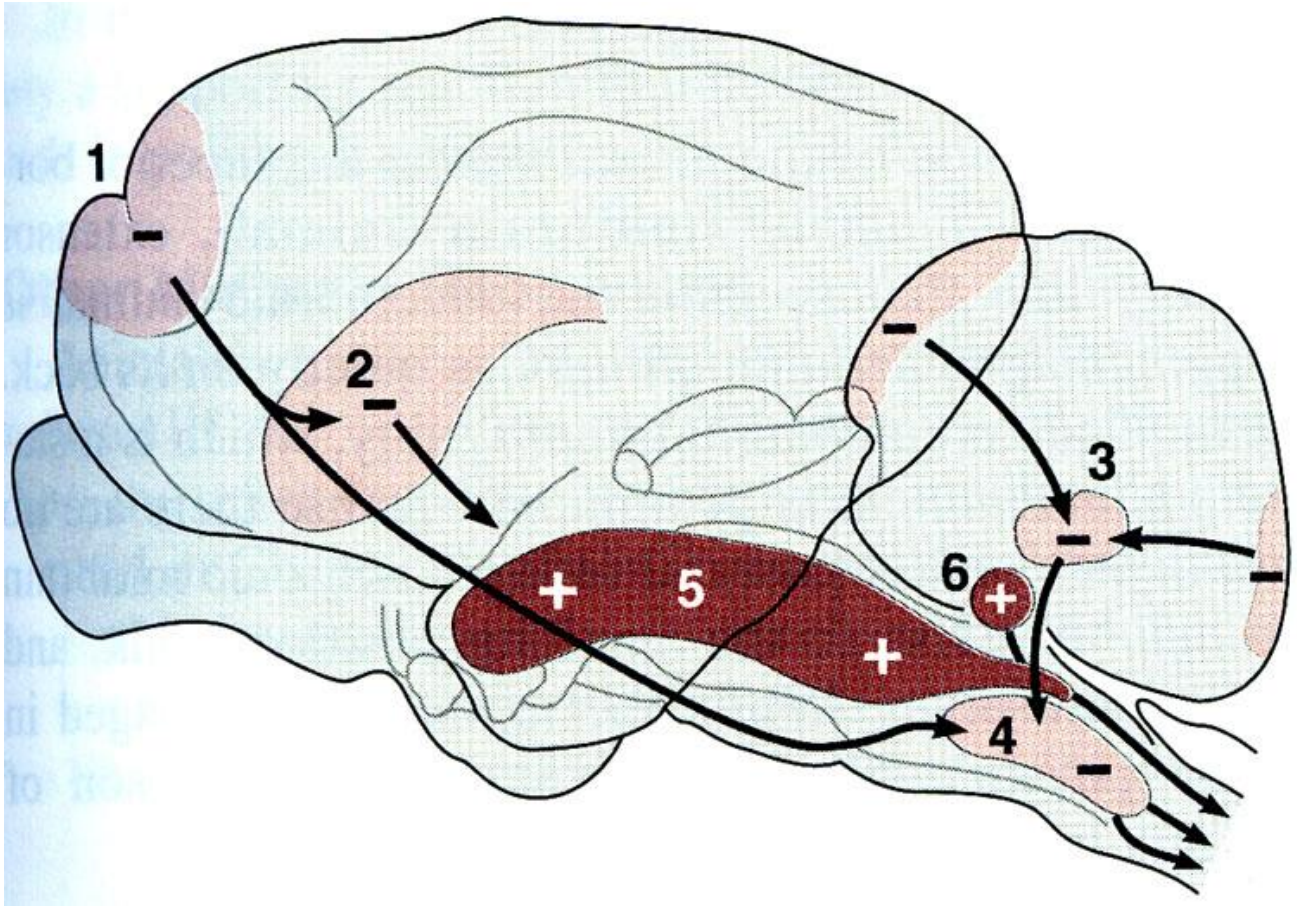


2. Inhibitory area –medullary reticular system

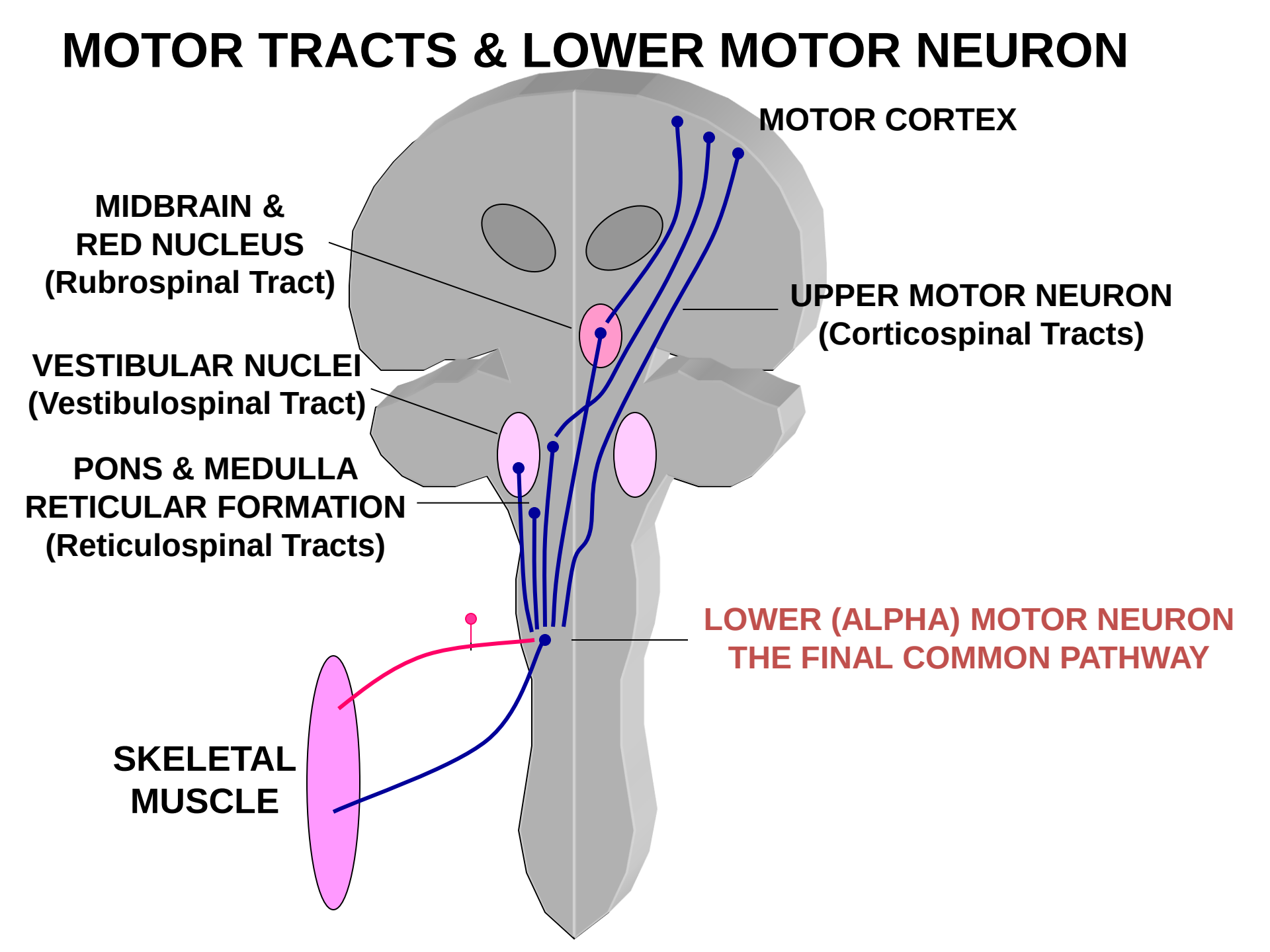
(1) Extend the entire extent to the medulla, lying ventrally and medially near the middle.

(2) Transmit inhibitory signals to the same antigravity anterior motor neurons (medullary reticulospinal tract).

1. motor cortex; 2. Basal ganglia; 3. Cerebellum; 4. Reticular inhibitory area; 5. Reticular facilitated area; 6. Vestibular nuclei.



MOTOR TRACTS & LOWER MOTOR NEURON

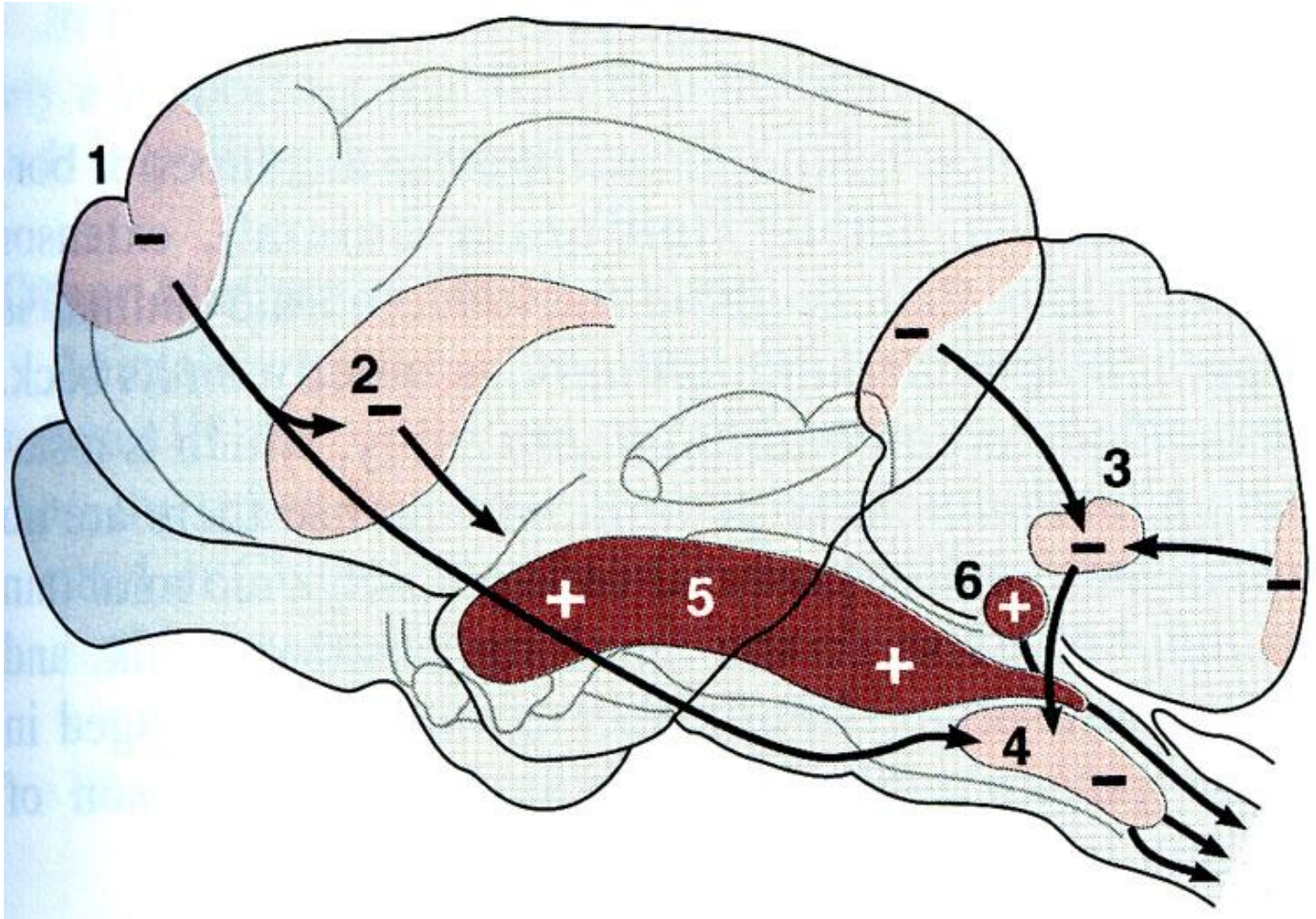


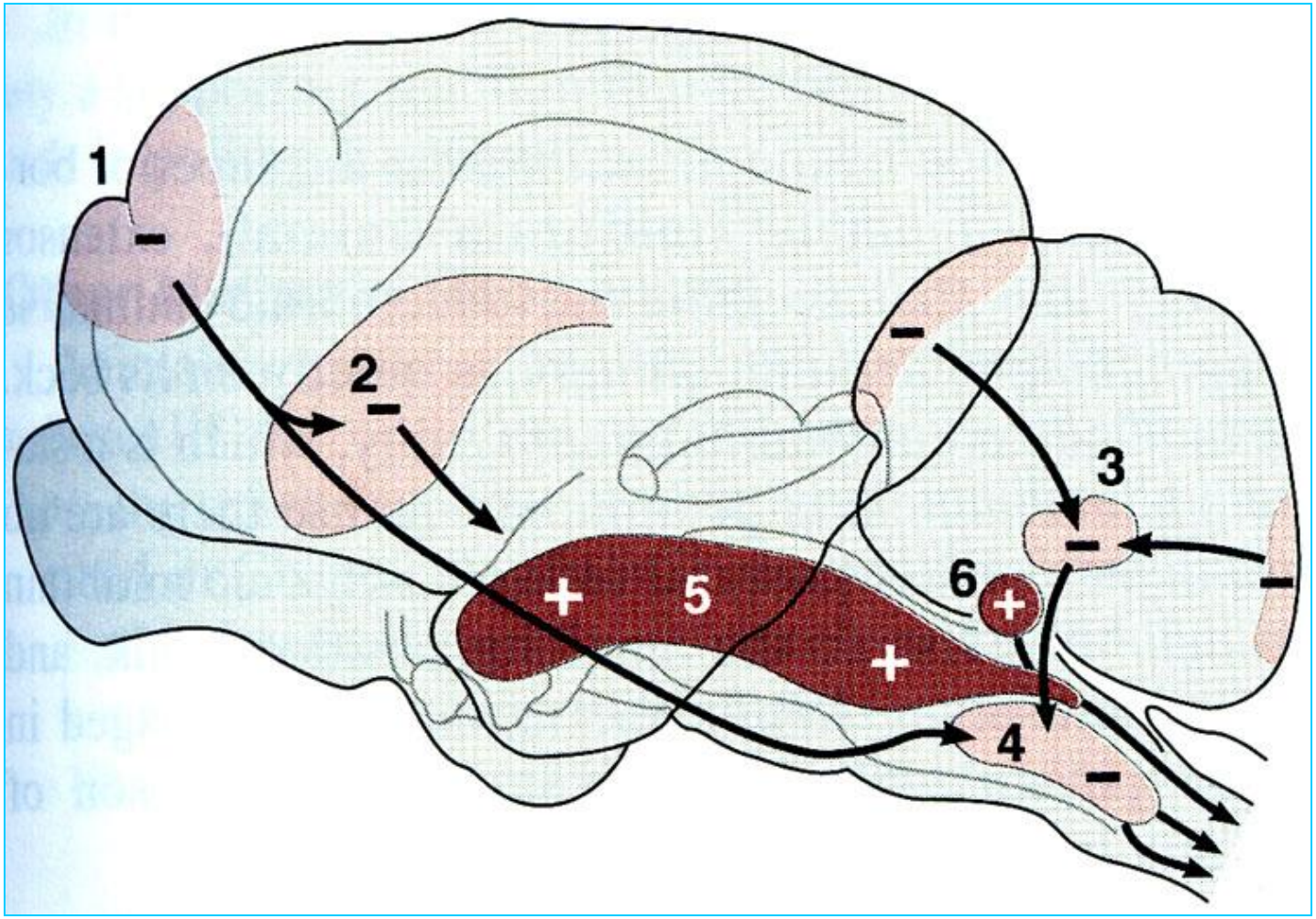
(3) Receive collaterals from the corticospinal tract; the rubrospinal tracts; and other motor pathways.

These collaterals activate the medullary reticular inhibitory system to balance the excitatory signals from the P.R.S.,

so that under normal conditions, the body M. are normally tense.

1. motor cortex; 2. Basal ganglia; 3. Cerebellum; 4. Reticular inhibitory area; 5. Reticular facilitated area; 6. Vestibular nuclei.





Areas in the brain where stimulation produces facilitation (+) or inhibition (-) of stretch reflexes. 1. motor cortex; 2. Basal ganglia; 3. Cerebellum; 4. Reticular inhibitory area; 5. Reticular facilitated area; 6. Vestibular nuclei.

Spasticity	Rigidity
1. It is seen following the lesion of the pyramidal tract (corticospinal tract). The commonest site of lesion being the *internal capsule*.	1. It is seen following the lesion of the basal ganglia, therefore, called the ***extrapyramidal rigidity***.
2. It involves only one group of the muscle either agonist or antagonist. Usually antigravity muscles are involved.	2. It involves both the agonist as well as antagonist muscles, therefore, hypertonia is more uniform and often is so distributed as to produce a general attitude *of flexion* of the limbs and trunk.
3. It describes a state of increased tone which is of *clasp-knife* type *i.e.* sequence of resistance to flexion followed by relxation when a limb is moved passively.	3. Hypertonia described here is of two types: (i) ***Lead-Pipe Rigidity*** – passive movement of an extremity meets with a plastic dead feeling resistance as if bending a lead pipe. (ii) ***Cog-Wheel Rigidity*** – The resistance to passive movement of an extremity is regularly or irregularly variable. This is described as like a lever rubbing on the teeth of a cog-wheel i.e. a series of catches during passive movement of the extremity.

Postural Reflexes

- Impossible to separate postural adjustments from voluntary movement
- maintain body in up-right balanced position
- provide constant adjustments necessary to maintain stable postural background for voluntary movement
- adjustments include static reflexes (sustained contraction) & dynamic short term phasic reflexes (transient movements)

Postural Control (cont)

- A major factor is variation of in threshold of spinal stretch reflexes
- caused by changes in excitability of motor neurons & changes in rate of discharge in the gamma efferent neurons to muscle spindles

Posture

- Represents overall position of the body & limbs relative to one another & their orientation in space
- Postural adjustments are necessary for all motor tasks & need to be integrated with voluntary movement

Postural Adjustments

- Functions
  - support head & body against gravity
  - maintain center of the body's mass aligned & balanced over base of support on the ground
  - stabilize supporting parts of the body while others are being moved
- Major mechanisms
  - anticipatory (feed forward)-predict disturbances
    - modified by experience; improves with practice
  - compensatory (feedback)
    - evoked by sensory events following loss of balance

Table 12–2. Principal postural reflexes.

Reflex	Stimulus	Response	Receptor	Integrated in
Stretch reflexes	Stretch	Contraction of muscle	Muscle spindles	Spinal cord, medulla
Positive supporting (magnet) reaction	Contact with sole or palm	Foot extended to support body	Proprioceptors in distal flexors	Spinal cord
Negative supporting reaction	Stretch	Release of positive supporting reaction	Proprioceptors in extensors	Spinal cord
Tonic labyrinthine reflexes	Gravity	Contraction of limb extensor muscles	Otolithic organs	Medulla
Tonic neck reflexes	Head turned: (1) To side (2) Up (3) Down	Change in pattern of extensor contraction: (1) Extension of limbs on side to which head is turned (2) Hind legs flex (3) Forelegs flex	Neck proprioceptors	Medulla
Labyrinthine righting reflexes	Gravity	Head kept level	Otolithic organs	Midbrain
Neck righting reflexes	Stretch of neck muscles	Righting of thorax and shoulders, then pelvis	Muscle spindles	Midbrain
Body on head righting reflexes	Pressure on side of body	Righting of head	Exteroceptors	Midbrain
Body on body righting reflexes	Pressure on side of body	Righting of body even when head held sideways	Exteroceptors	Midbrain
Optical righting reflexes	Visual cues	Righting of head	Eyes	Cerebral cortex
Placing reactions	Various visual, exteroceptive, and proprioceptive cues	Foot placed on supporting surface in position to support body	Various	Cerebral cortex
Hopping reactions	Lateral displacement while standing	Hops, maintaining limbs in position to support body	Muscle spindles	Cerebral cortex

Functions	Preparation[a]						Level of Integration
	Normal	Decorticate[b]	Midbrain	Hindbrain (Decerebrate)[c]	Spinal	Decerebellate	
Initiative, memory, etc.	+	0	0	0	0	+	Cerebral cortex required
Conditioned reflexes	+	+[d]	0	0	0	+	Cerebral cortex facilitates
Emotional responses	+	++	0	0	0	+	Hypothalamus, limbic system
Locomotor reflexes	+	++	+	0	0	Incoordinate	Midbrain, thalamus
Righting reflexes	+	+	++	0	0	Incoordinate	Midbrain
Antigravity reflexes	+	+	+	++	0	Incoordinate	Medulla
Respiration	+	+	+	+	0	+	Lower medulla
Spinal reflexes[e]	+	+	+	+	++	+	Spinal cord

[a]0 = absent; + = present; ++ = accentuated.

[b]Cerebral cortex removed.

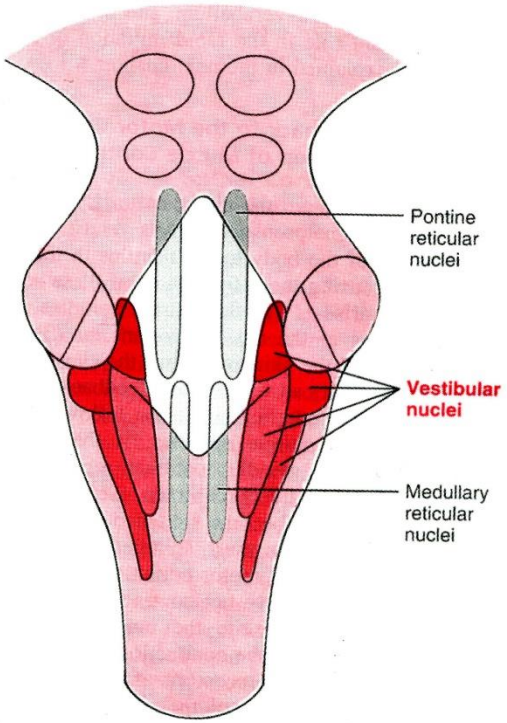
[c]Brain stem transected at the top of the pons.

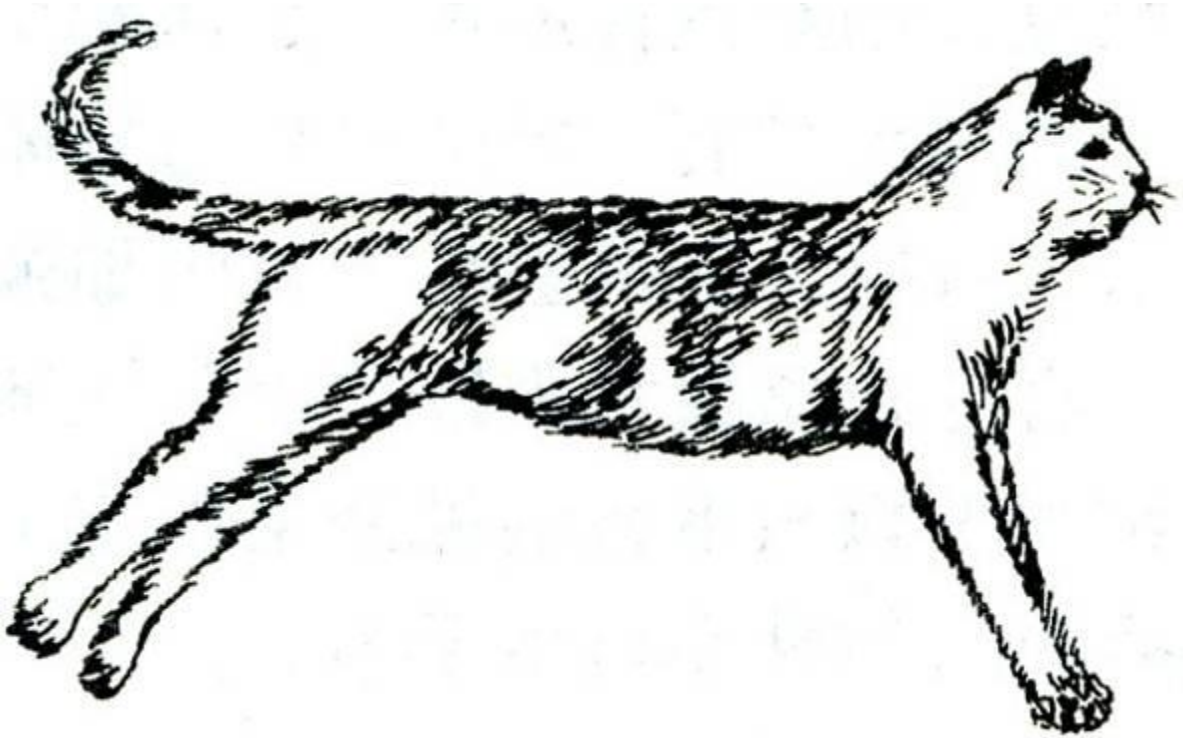
[d]Conditioned reflexes are more difficult to establish in decorticate than in normal animals.

[e]Other than stretch reflexes.

Decerebrate Rigidity

- Decerebrate Rigidity: Transection of the brainstem at midbrain level (above vestibular nuclei and below red nucleus)
- Symptoms include:
  - extensor rigidity or posturing in both upper and lower limbs

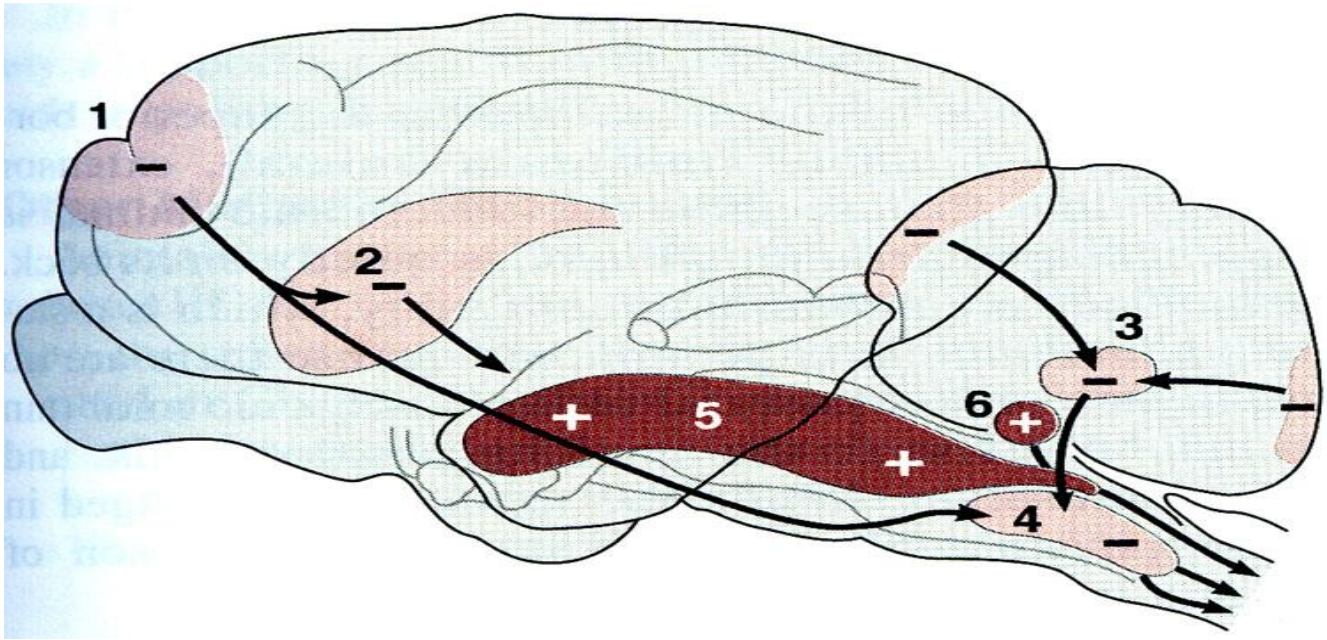




- Results from:

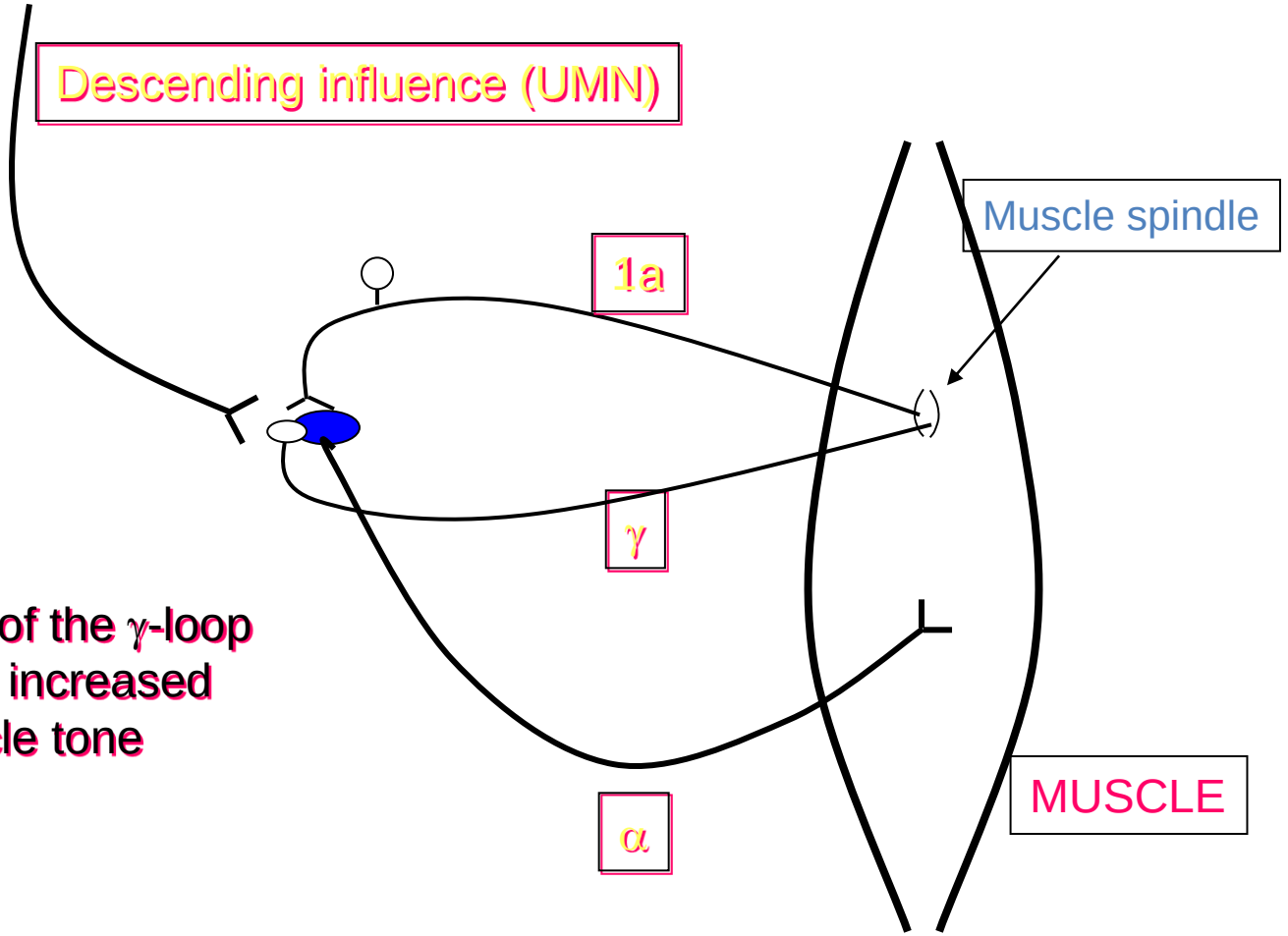
  –-loss of input from inhibitory medullary RF (activity of this center is dependent on input from higher centers).

  –-active facilitation from pontine RF (intrinsically active, and receives afferent input from spinal cord).



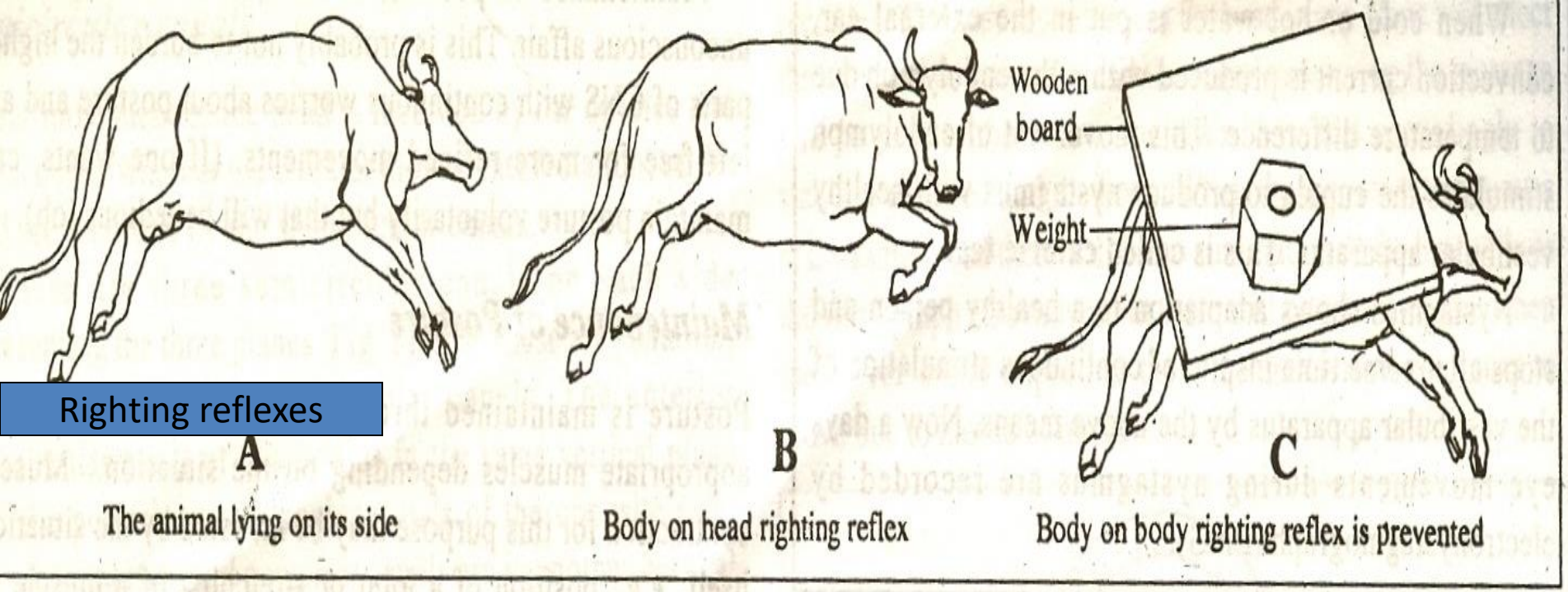
- The extensor rigidity is γ-loop dependent

  –section the dorsal roots interrupts the γ-loop, and the rigidity is relieved. This is γ-rigidity.

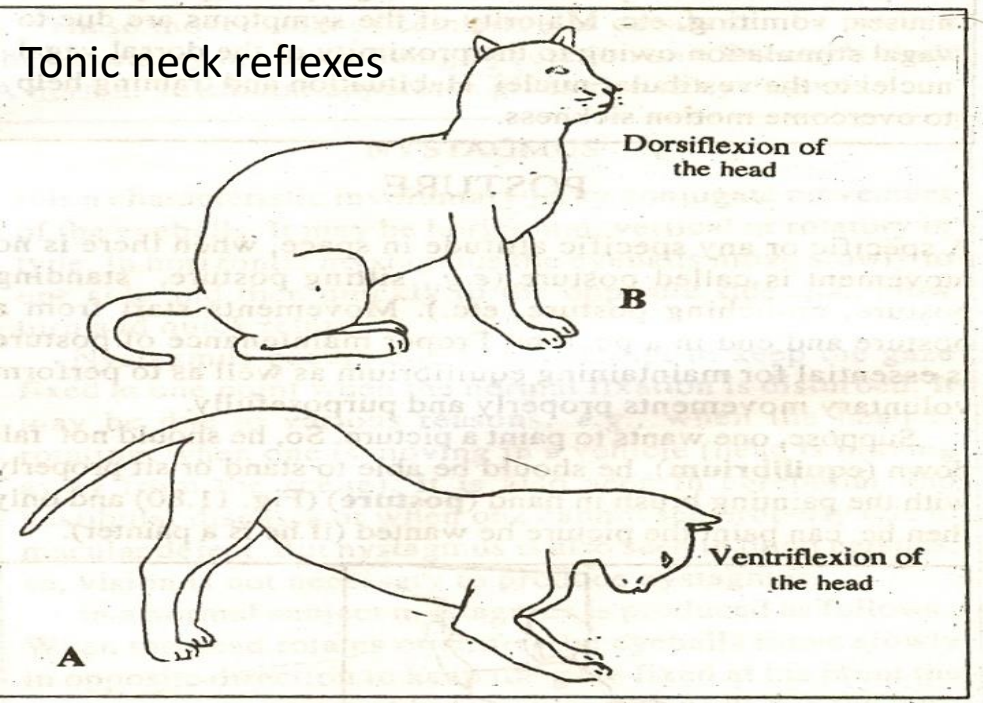


Activation of the γ-loop results in increased muscle tone

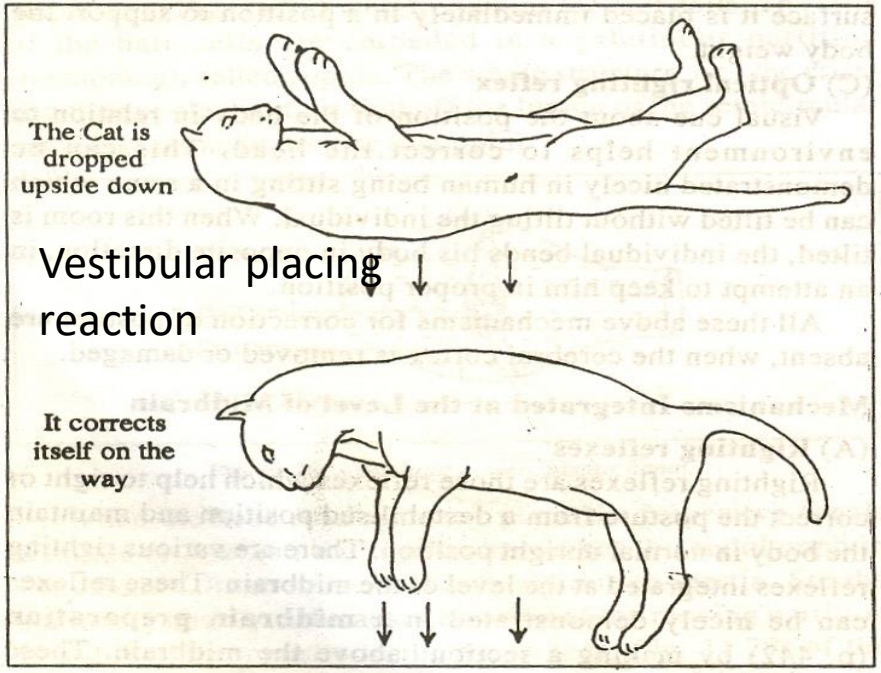
Righting reflexes



Tonic neck reflexes



Vestibular placing reaction



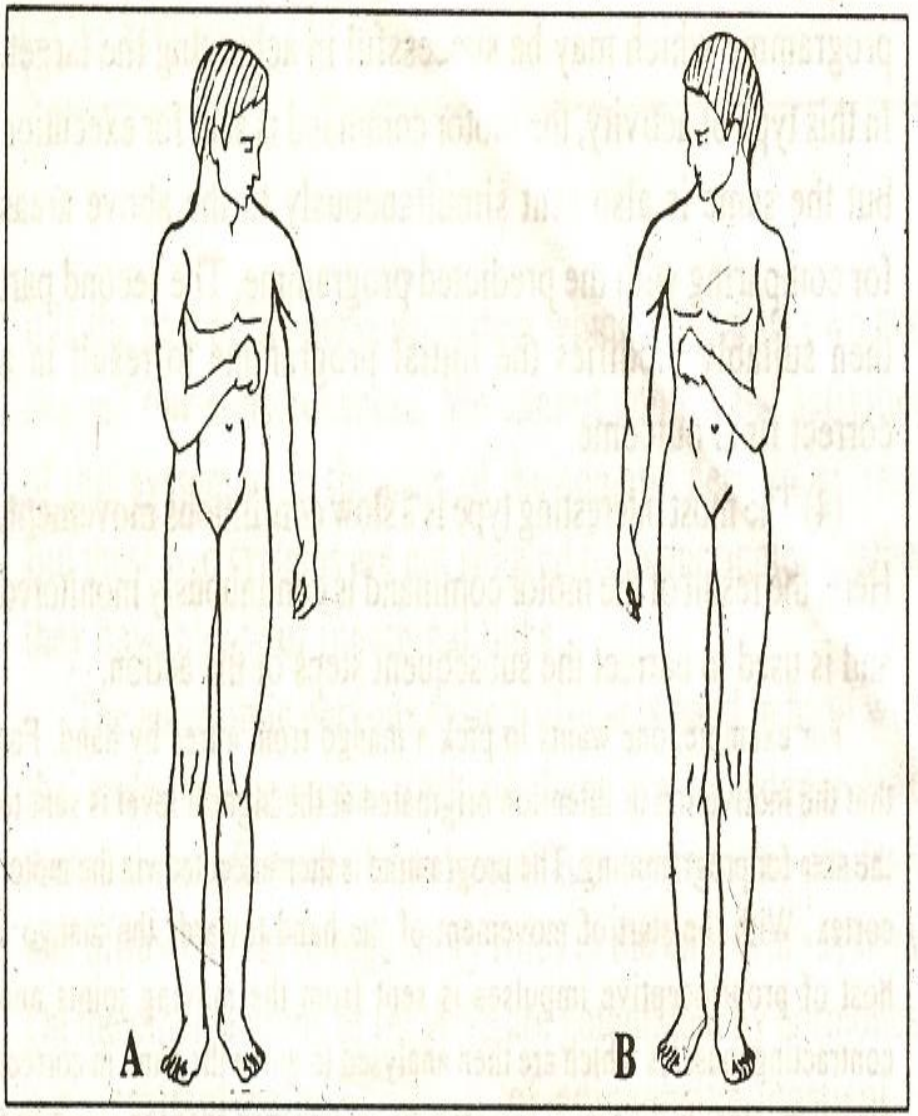


Fig. 11.84. *Tonic neck reflex.*
A. *The head is turned to the left and the left upper limb is extended while the right limb is flexed.*
B. *Shows when the head is turned to the right.*

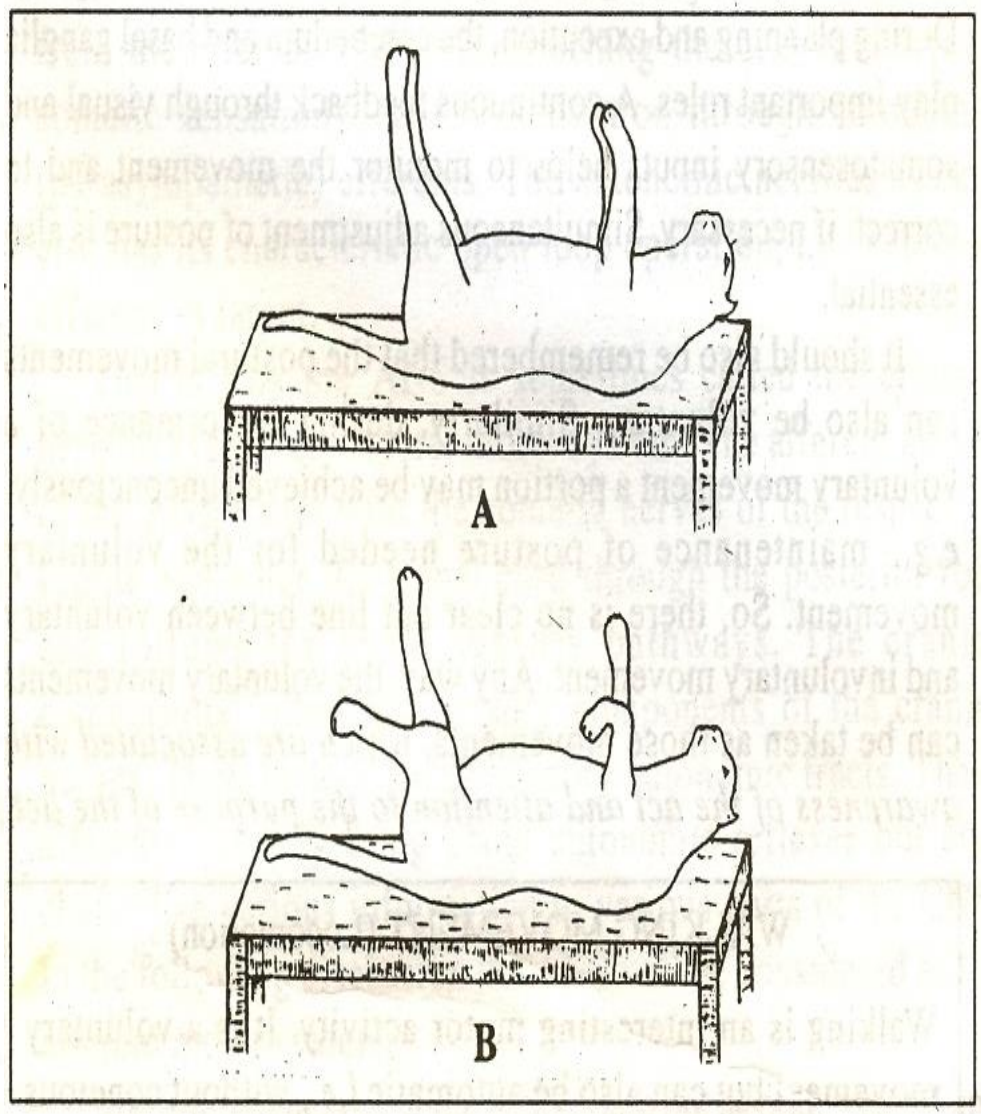


Fig. 11.85. *Tonic labyrinthine reflex.*
A. *All four limbs are extended.*
B. *Left sided limbs are flexed after destruction of the left vestibular apparatus.*