

# Physiology of Postural Reflexes



# Objectives:

- ❖ Define human posture.
- ❖ Explain what are postural reflexes and their overall function.
- ❖ Know the centers of integration of postural reflexes.
- ❖ Describe decorticate rigidity and decerebrate rigidity and explain the mechanisms underlying them.

## Color index:

- ❖ **Important.**
- ❖ **Girls slide only.**
- ❖ **Boys slide only.**
- ❖ **Dr's note.**
- ❖ Extra information.



**Editing File**

# What is Posture?

- ❖ It is maintenance of upright position against gravity (center of body is needed to be between the legs) it needs antigravity muscles.
- ❖ Posture is the attitude taken by the body in any particular situation like standing posture, sitting posture, etc. even during movement, there is a continuously changing posture
- ❖ The basis of posture is the ability to keep certain group of muscles in sustained contraction for long periods. Variation in the degree of contraction and tone in different groups of muscle decides the posture of the individual.

## Postural Reflexes

### Males

These reflexes resist displacement of the body caused by gravity or acceleratory forces, and they have the following functions:

1. Maintenance of the upright posture of the body.
2. Restoration of the body posture if disturbed.
3. Providing a suitable postural background for performance of voluntary movements.

### Females

1. Up-right posture need postural reflexes
2. posture depends on muscle tone [Static stretch reflex](#)( stretch reflex) ( basic postural reflex)
3. The main pathways concerned with posture are:-

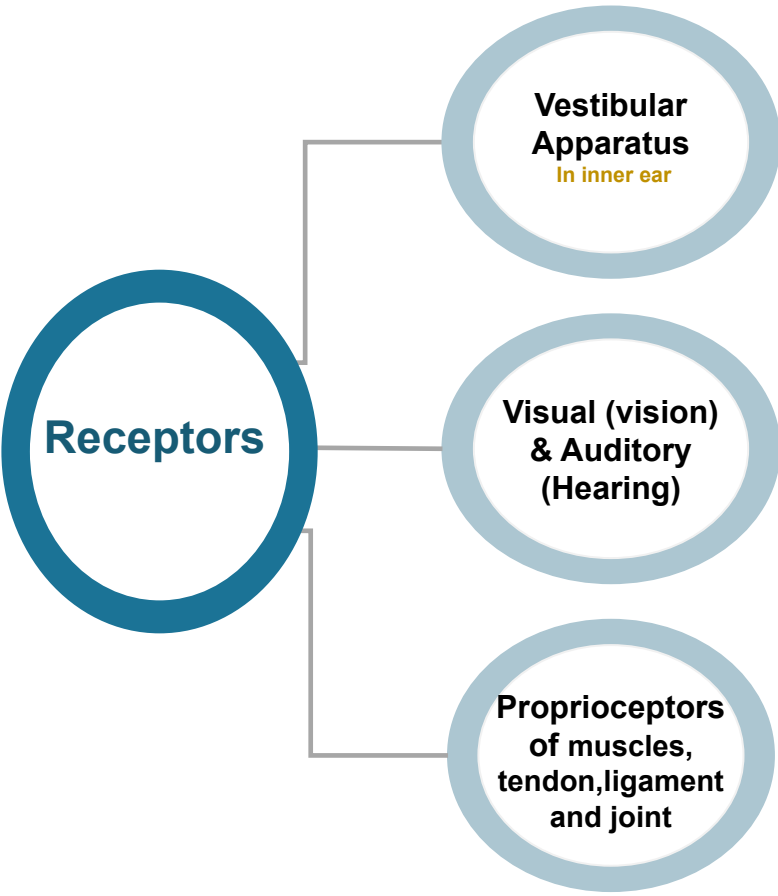
A- medial tracts control proximal limbs & axial muscles for posture & gross movements [as Ventral corticospinal](#)

B- lateral pathways as (corticospinal –rubrospinal) control distal limbs.



# Postural Reflexes

postural reflexes depend on the following receptors:



Maculae (utricle & saccule) & SCC crista.

Maculae for linear acceleration & orientation of head in space.

SCC crista for angular acceleration.

- Vision can compensate for loss of auditory, vestibular & proprioception.

- (Tabes dorsalis +ve Rombergism), syphilitic myelopathy

- If patient with sensory ataxia stands with eyes closed, he falls, down. يغمض عيوننه ويقرب رجليه من بعض

**A-Neck Proprioceptors:-**

detect head position in relation to trunk.

**B-Body Proprioceptors:-**

proprioceptors of anti-gravity muscles.

**C-pressure receptors:-**

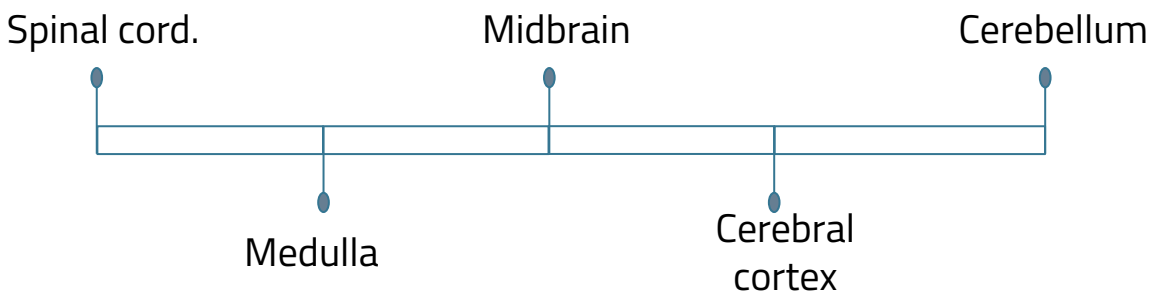
as in sole of feet initiate positive supporting reaction ( magnet reflex).



sensory ataxia is the result of disruption of neuronal pathways that interfere with proprioception, dysfunction of the dorsal columns of the spinal cord

In Peripheral neuropathies -DM, Idiopathic neuropathies

Stretch reflexes & postural reflexes can be modified by coordinated activity:



# Postural Reflexes Are:

L17

- Static Reflexes (at rest)
- Phasic Reflexes (**with motion**) (Statokinetic reflexes)

## 1 ➤ Static (Statotonic) Reflexes

- ❖ Involved sustained contraction of muscles
- ❖ Maintain posture at rest
- ❖ **Include the following reflexes:**

- A** ➤ Spinal      **B** ➤ Medullary Reflex      **C** ➤ Righting Reflex (Midbrain)

### A- Spinal Centre in Spinal Cord

we cut above C5 because we don't want to paralyse the diaphragm

#### Local Static Reflexes

\*Confine to stimulated limb\*

#### Segment Static Reflex

Mediated by one segment of SC  
as:

##### Stretch Reflex

- This is the most important local static reflex which controls the tone in those extensor muscles which keep the body upright (antigravity muscles).

##### Positive supporting reaction (Magnet reflex)

- Deep pressure on the sole lead to contraction of both flexors & extensors to convert the whole lower limb into a rigid column to support body weight.

-Receptors are proprioceptors of flexors

-Protective reflex

##### Crossed Extensor Reflex

To maintain the posture

##### Negative Supporting Reflex

- which disappearance (**release**) of +ve supporting reaction

- (receptors are proprioceptors of extensors of the released limb)

N.B spinal R can be studied in spinal animal with cut at neck b/w the S.C & brain stem so all S.C is intact.

# B- Medullary Centre in Medulla Oblongata

receptors are:  
1- otolith  
2- neck proprioceptors

we destroy the labyrinth to prove that the reflex is integrated in the medulla

## Neck Static Reflex

We can see the reflexes in children below 2 years because the tracts are unmyelinated yet

( studied in a decerebrated animal cut above medulla + labyrinth destroyed)  
- Stimulus is :changing head position that (+) neck proprioceptors

### Ventroflexion of Head

- Arms (**Forelimbs**) flexion + extend hindlimb (as in decortication).

### Dorsiflexion of Head

-Arms(**Forelimbs**) extended + flexion hindlimb.

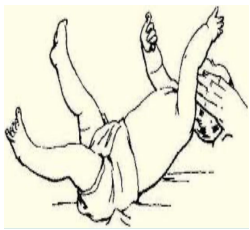
### Turning head to one side

Extension of limbs on that side + flexion of other side (as in decortication).

## Labyrinthine Static Reflex

we do deafferentation of C1 - C2 - C3

- (In decerebrated animal ) + ( elimination of neck proprioceptors) ( labyrinth intact)  
- Receptors are otolith organs (maculae )  
- Stimulus is gravity  
1- Ventroflexion of head (animal in prone position)>> 4 limbs flexion.  
2- Dorsiflexion of head (the animal in supine position) >>4 limbs extended ( as in decerebration ).





# C- Righting Reflex (RR)


Center in midbrain except the visual in Cerebral cortex

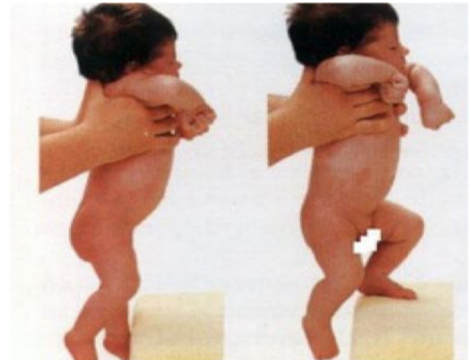
L17

- ❖ when upright posture is disturbed as in falling down → Righting reflex
- ❖ These reflexes are for correction of disturbed posture
- ❖ Head correction is first followed by body correction
- ❖ Studied in a midbrain animal (cut above midbrain)
- ❖ Initiated by signal from otolith organs, neck proprioceptors, pressure receptors of the body as well as from visual receptors
- ❖ All static labyrinthine reflexes have macula as receptors, but in statokinetic reflexes during motion SCC receptors (macula act in linear & SCC receptors act in angular acceleration)

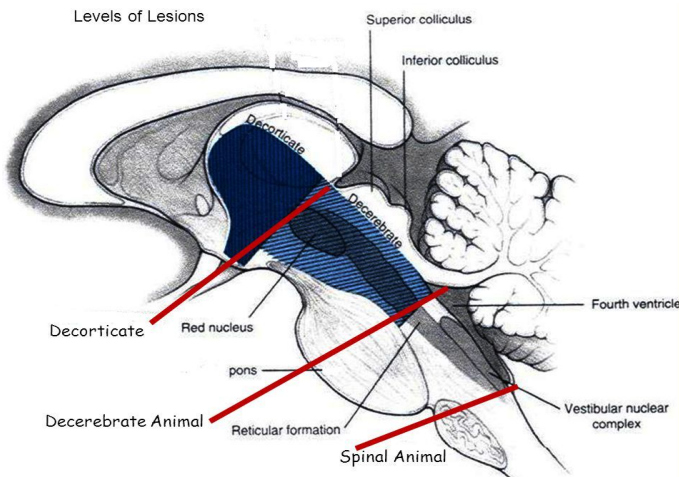
Reflexes	Centre	Stimulus	Receptor	Response/ Reflex
<p>vision can compensate for proprioceptors and otolith</p> <p><b>Visual RR</b> Studied in intact animal with destroyed labyrinth and cutting upper 3 cervical nerves. <small>males slides</small></p>	Center in cerebral cortex	visual stimuli	eye receptors	<p>If this animal is thrown in air, visual image can correct position of head &amp; body.</p> <p>Visual image can correct position of head &amp; body if position is disturbed</p>
<p><b>Labyrinthine RR</b></p> <p></p>	Midbrain	<p>- (covered eyes) نتأكد انه مافي visual clue &amp; animal held in air from pelvis)</p> <p>- The body is not in the proper position</p>	<p><b>otolith organs</b> As in tilting the head &amp; head is not in proper site → stimulates the otolith organs → stimulate neck muscles to correct the head level</p>	righting of head
<p><b>Body on Head RR</b> (studied in midbrain animal with destroyed labyrinth) <small>males slides</small></p>		pressure on side of body & <u>head is free.</u>	trunk proprioceptors body pressure receptors	correction of head
<b>Body on Body</b>		pressure on side of the body and <u>head is fixed.</u>	trunk proprioceptors body pressure receptors	correction of body
<p><b>Neck RR</b></p> <p></p>		Stretch of neck muscles (As if head is corrected & body still tilted)	Muscle spindles of neck muscles	Righting of shoulders & then righting of body.

- ❖ Maintain posture during motion
- ❖ Integrated in the cerebral cortex
- ❖ Involve transient contraction of muscles

Reaction	A- Hopping Reaction لما تركل بسة وتوقف ع اطر افيها مره ثانيه	B- Placing Reaction 
Stimulus	When animal is pushed laterally (The majority of its weight is only in one limb))	Blind folded animal suspended in air & moved towards a supporting surface
Receptor	Muscle spindle	touch receptors & proprioceptors in soles of feet
Response	hopping to keep limbs in position to support body.	the feet will be placed firmly on the supporting surface



## Decerebrate Rigidity & Decorticate Rigidity



### POSTURING

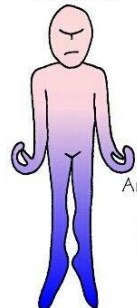
DECORTICATE (Flexor)



Arms are like "C's" Moves in toward the "Cord"

Problems With Cervical Spinal Tract or Cerebral Hemisphere.

DECEREBRATE (Extensor)



Arms are like "e's"

Problems Within Midbrain or Pons.



# Decerebrate rigidity

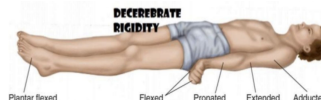
[Click here to see the table](#)

L17

## Definition

- it is a mid-collicular lesion below red nucleus (section between superior & inferior colliculi of midbrain)
- block inhibitory signals from brain & red nucleus to tonically active pontine reticular formation & Vestibular N

## causing:



01

Maintained tonic static postural reflexes that support animal against gravity ( Medullary tonic neck R & Medullary labyrinthine R )

02

Absent midbrain righting R

03

Extension of head & 4 limbs extensors ( as in labyrinthine static R ) The jaw may be clenched with the neck hyperextended due to increased extensor tone from vestibulospinal & reticulospinal tracts to extensor motor neuron

04

spasticity & rigidity & extension in antigravity muscles

01

Extensive extensor posture of all extremities → Rigidity of all limbs

02

All limbs extended arms extended by the sides & rotated internally because its above rubrospinal tract which activate flexors

03

hallmark : elbows extended

04

Head may be arched to the back

In human is rare and may be caused by a vascular lesion of brain stem between red nucleus & vestibular nucleus

## Mechanism of Decerebrate Rigidity:

Diffuse facilitation of stretch reflex due to:

1. increase excitability of motor neuron
2. increase gamma discharge

**Lesion:** \*Male slides

Lesion **below** red nucleus, resulting in block normal inhibitory signals from brain & red nucleus in midbrain to tonically active pontine reticular formation & vestibular formation



## in decerebrate animal

\*Male slides

damage to (level below red nucleus)

### Features of decerebrate rigidity :

- hyperextension of all four limbs
- the animal can be made to stand on four limbs but is easily toppled by slight push
- extreme hyperextension of the spine (opisthotonus) produces concave configuration of the back
- dorsiflexion (hyperextension) of tail and head

Reflexes that are lost/absent	Reflexes that are retained /still present (those which have their centers in SC, medulla or pons)
Righting Reflex	-Stretch reflex -positive&negative supporting reaction -crossed extensor reflex
	Tonic Labyrinthine reflexes
	Tonic Neck Reflexes

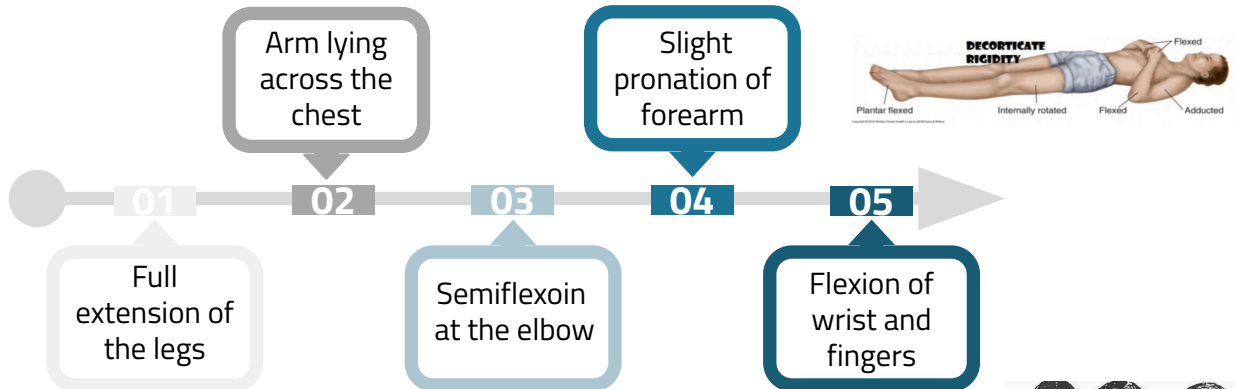
# Decorticate rigidity

flexion because rubrospinal is intact (above red nucleus)

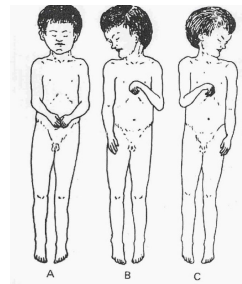
## Definition

- it is a lesion in cerebral cortex but brain stem is intact, as what seen in hemiplegic patients after Hemorrhage of internal capsule which causes UMNL (damage to upper motor neurons)
- it is more common in human than -decerebrate rigidity

### Typical features in decorticated man consist of:



- > the hands are clenched into fists, and the legs extended and feet turned inward
- > Decorticate rigidity is seen at rest
- > Turning the head to one side initiates tonic neck reflexes e.g turning head to the left >>> extension of limbs on left side & flexion of right side



### Lesion:

- In decorticate rigidity the lesions is **above** the red nucleus so rubrospinal are intact together with pontine reticulospinal and the vestibulospinal this leads to the characteristic flexion posturing of the upper extremities and extensor posturing of the lower extremities.
- Normally suppressor area 4 strip in the anterior edge of precentral gyrus inhibit red nucleus, if this inhibition is lost by decortication >>> disinhibition of the red nucleus, so facilitate the rubrospinal tract to flex U.L
- Also/ there is loss of inhibitory cortical signals (from suppressor area 4 to gamma motor neurons via reticulospinal)

Reflexes that are lost/absent	Reflexes that are retained /still present
Placing Reaction	Tonic Labyrinthine reflexes
Hopping Reaction	Tonic Neck Reflexes
Visual righting reflex	Other Righting Reflexes

# Summary

L17

Reflexes	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 extensor	Spinal cord
Tonic labyrinthine reflexes	Gravity	Construction 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 one side to witch head is turned (2) Hind legs flex (3) Forlegs flex	Neck proprioceptors neck	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	Exteroreceptors	Midbrain
Body on Body righting reflexes	Pressure on side of body	Righting of body even when head held sideways	Exteroreceptors	Midbrain
Optical righting reflexes	Visual cues	Righting of head	Eyes	Cerebral cortex
Placing reactions	Various visual, extero-ceptive, and proprio-ceptive 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

**Q1: Which of the following can compensate for loss of auditory, vestibular & proprioception?**

- A. Vestibular Apparatus
- B. Neck Proprioceptors
- C. Vision receptors
- D. Proprioceptors of muscle

**Q3: Which of the following is the Receptors for Labyrinthine Static Reflex?**

- A. Otolith organs
- B. SCC receptors
- C. muscle spindles
- D. eye receptors

**Q5: in which of the following is the Decerebrate Rigidity lesion ?**

- A. between the superior and inferior colliculi of the midbrain
- B. cerebral cortex
- C. pons
- D. internal capsule

**Q2: Which of the following is true during Ventroflexion of head in Neck Static Reflex?**

- A. Arms extended + flex hindlimb.
- B. Arms flexion + extend hindlimb
- C. Arms and hindlimb extended
- D. Extension of limbs on that side + flexion of other side

**Q4: all of the following are Midbrain Righting Reflexes except?**

- A. Labyrinthine RR
- B. Visual RR
- C. Body RR
- D. Neck RR

**Q6: Which of the following is the Receptor of Hopping reaction ?**

- A. touch receptors
- B. proprioceptors in soles of feet
- C. muscle spindles
- D. otolith organs

6: C  
5: A  
4: B  
3: A  
2: B  
1: C  
key:  
answer

**1- What are the Stimulus, Receptor and Response in Negative supporting reaction?**

**2- What are the proprioceptors of muscles, tendon, ligament and joint in Postural Reflexes?**

**3- mention 3 Typical features in a decorticated man ?**

**4- mention one of the Reflexes that are lost and two of the reflexes that are still present in Decerebrate Rigidity**

**A1: Stimulus: Stretch, Response: Release of positive supporting reaction, Receptor: Proprioceptors in extensors**

**A2: A- Neck Proprioceptors: -detect head position in relation to trunk.**

**B- Body Proprioceptors: -proprioceptors of anti-gravity muscles.**

**C- Pressure receptors: -as in sole of feet initiate positive supporting reaction (magnet reflex).**

**A3: Full extension of the legs - Arm lying across the chest - Semiflexion at the elbow**

**A4: lost : Righting Reflexes / still present : Tonic Labyrinthine reflexes - Tonic Neck Reflexes**

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