Postural Reflexes

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Objectives

- At the end of this lecture the student should be able to:

- 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 .

What Is Posture?

- 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

- 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

Postural Reflexes-2

- Postural reflexes depends on the following receptors:-

- 1- Vestibular apparatus receptors as
  - Maculae (utricle & saccule) & SCC cristae.

- 2- Visual (vision) & auditory(hearing) receptors:- Vision can compensate for loss of auditory, vestibular & proprioception
  - -(Tabes dorsalis +ve Rombergism)

Postural Reflexes-3

- 3-Proprioceptors of muscles , tendons , ligaments & joints:-

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)

Stretch reflexes & postural reflexes can be modified by coordinated activity ;-

- Spinal cord
- Medulla
- Midbrain
- Cerebral cortex
- Cerebellum

Postural reflexes are:-

A-Static reflexes(at rest)

-Involve sustained contraction of muscles

B-Phasic reflexes (*Statokinetic reflexes*)

-Involve transient contraction of muscles

A-Static (statotonic) Reflexes

- Maintain posture at rest
- Include the following reflexes:

A- Spinal
B-Medullary reflexes
C-Righting reflexes (midbrain)

A-Spinal reflexes:- (Center in S.C)

1- local static reflexes:

Confine to stimulated limb.

i -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)

ii. 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

2- Segmental static reflexes:-

mediated by one segment of the spinal cord as :-

- A. Crossed extensor reflex
- B. Negative supporting R (which disappearance 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 Static Reflexes

- Center=medulla oblongata
- Two types;

- Tonic neck reflexes
- & tonic labyrinthine reflexes

B- Medullary Static Reflexe-2

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

1- Ventroflexion of head

Flexion of forelimbs + extension of hindlimbs

2-Dorsiflexion of head

Extension of forelimbs + flexion of hindlimbs.

3- Turning head to one side—

Extension of limbs on that side + flexion of other side.

2- Labyrinthine static reflex:-

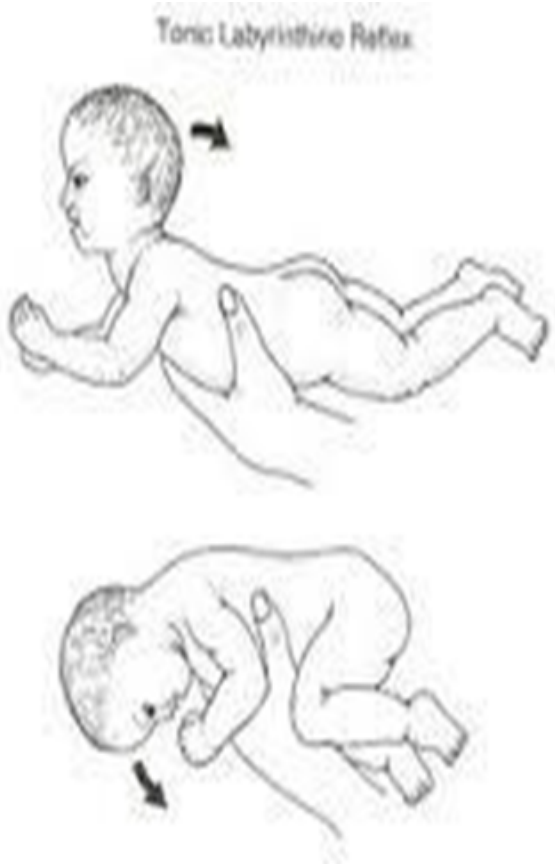
- (in decerebrated animal) + elimination of neck proprioceptors (labyrinth intact)

  - Receptors are otolith organs (maculae)

- -Stimulus is gravity

1-placing the animal in prone position----- 4 limbs flexion

2- the animal in supine position)-- ---4 limbs extended.



C- Righting Reflexes

- **Center is midbrain except the visual in C.C)**

- Theses 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 otlith organs, neck proprioceptors , pressure receptors of the body as well as from visual receptors

A- Midbrain Righting Reflexes

1. Labrinthine RR that correct head position

- (cover eyes) & animal held in air from pelvis)
- The body is not in the proper position
- As in tilting the head (+) otolith organs ->>>>-(+) neck muscles to correct the head level, when head is not in proper site.
- receptors; otolith organs,
- response; contraction of neck muscles lead to righting of head

- **2- Body RR corrects head position(Body on head RR):-**
  - studied in mid brain animal with destroyed labyrinth

- **stim: pressure on side of body& head is free**
- **receptors; body pressure receptors**
- **Response/ reflex correction of head .**

- **3- Neck righting reflexes corrects body position) :-**

- **Correction of the head by previous 2 reflexes lead to twisting of the neck. This initiates reflex righting of the body**
- **stim: stretch of neck muscles**
- **-righting of shoulders & body.**
- **receptors; proprioceptors of neck muscles**
- **response; righting of body.**

4- Body RRcorrects body position (Body on body RR) :

- pressure on side of the body and head is fixed)
- Receptors/ body pressure receptors
- response /reflex correction of body

B- Visual Righting Reflexes(cortical)

- *Studied in intact animal with destroyed labyrinth and cutting upper 3 cervical nerves*
  - If this animal is thrown in air, visual image can correct position of head & body .
- center is c.c -
- stim: visual stim,
- receptors; eye receptors,

B- Phasic reflexes (statokinetic reflexes)(center in C.C):-

- Maintain posture during motion
- Integrated in the cerebral cortex

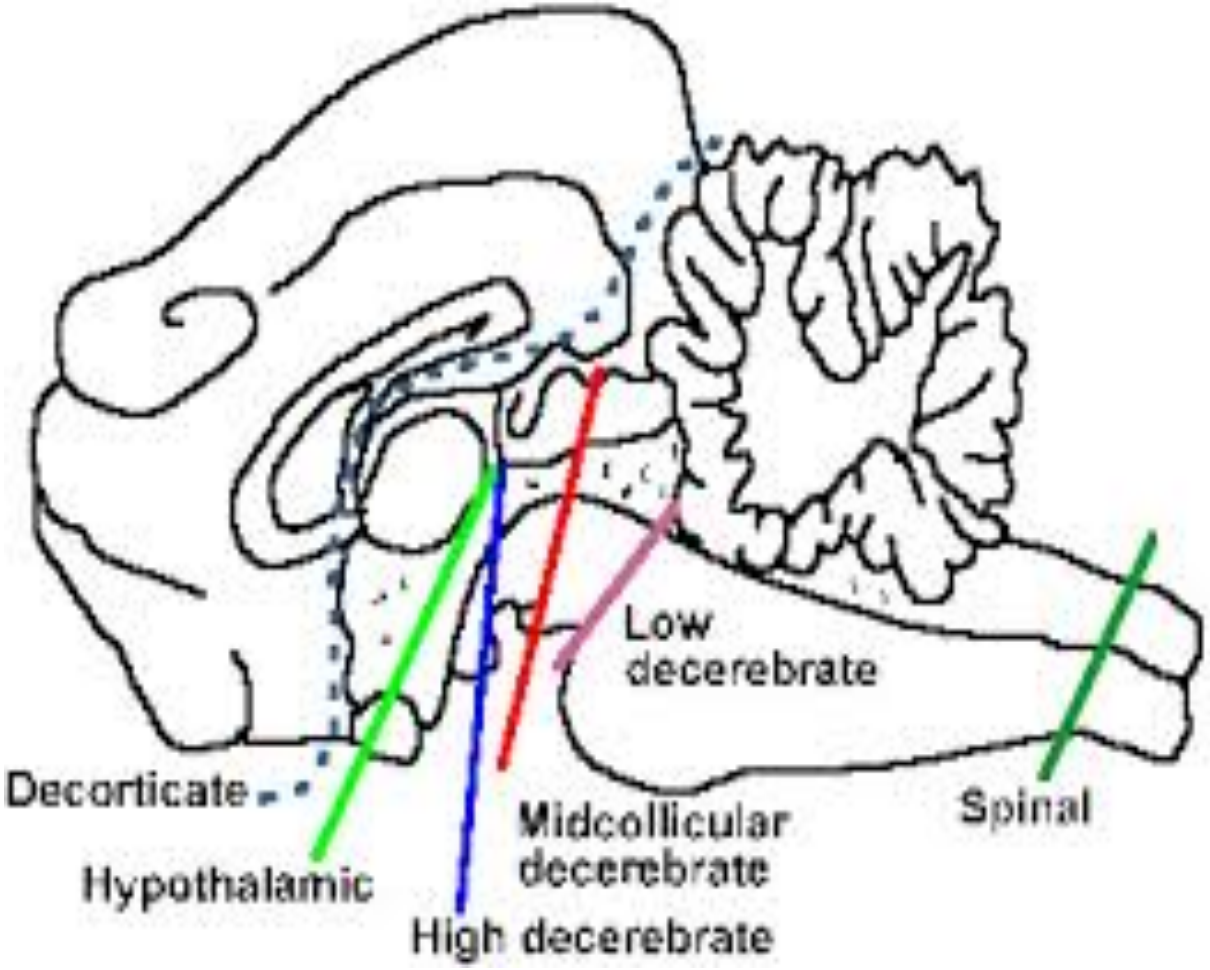
a- Hopping reaction:-

- When animal is pushed laterally }}}}} reflex hopping to keep limbs in position to support body.
- The receptors ;muscle spindle.

- b- Placing reaction :-

- Blind folded animal suspended in air & moved towards a supporting surface, the feet will be placed firmly on the supporting surface (receptors are touch receptors& proprioceptors in soles of feet)

Decerebrate rigidity& Decorticate rigidity

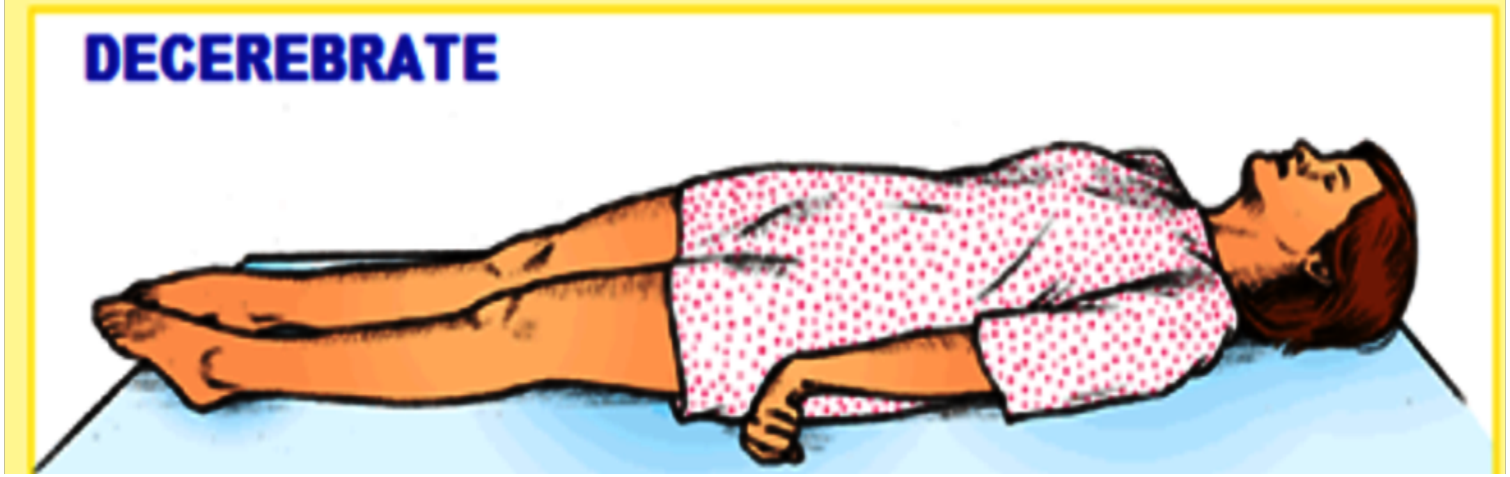


Decerebrate Rigidity

- ✓Site of lesion → between the superior and inferior colliculi of the midbrain , lesion below red nucleus resulting in
- ✓extensive extensor posture of all extremities → Rigidity of all 4 limbs
- ✓ All limbs extended arms extended by the sides & rotated internally
- ✓ (hallmark → elbows extended)
- ✓Head may be arched to the back

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

Decerebrate posture results from damage to the upper brain stem. In this posture, the arms are adducted and extended, with the wrists pronated and the fingers flexed. The legs are stiffly extended, with plantar flexion of the feet.



- **In a decerebrate animal :**
- damage to (level below red nucleus)
- **Features of decerebrate rigidity**
- - hyperextension of all four limbs
- - dorsiflexion (hyperextension) of tail and head
- - extreme hyperextension of the spine(opisthotonus) produces concave configuration of the back
- - the animal can be made to stand on four limbs but is easily toppled by slight push
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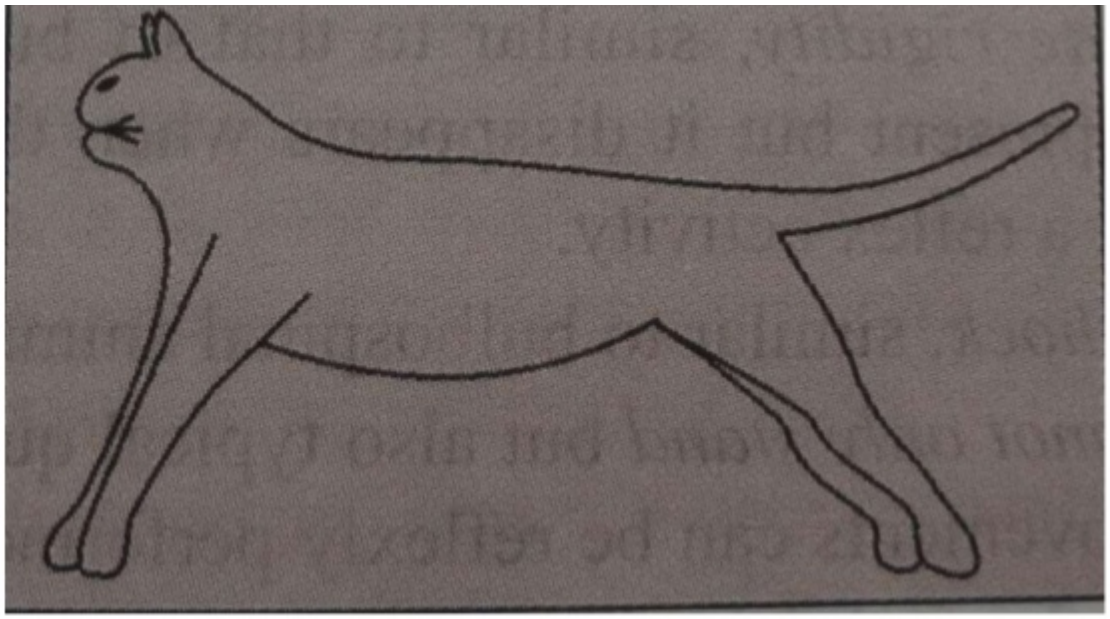

- **Reflexes that are lost/absent**
  - Righting Reflexes
- **Reflexes that are retained /still present**
- (i.e., reflexes those which have their centers in SC, medulla or pons):
- Stretch reflex, positive & negative supporting reaction, crossed extensor reflex
- Tonic Labyrinthine reflexes
- Tonic Neck Reflexes
- **Mechanism of Decerebrate Rigidity**
- Diffuse facilitation of stretch reflex due to:

1.increase excitability of motor neuron

2. increase gamma discharge

✓lesion below red nucleus , resulting in block normal inhibitory signals from brain & red nucleus in midbrain to tonically active pontile reticular formation & Vestibular. N .

Decorticate Rigidity

- In humans , where true decerebrate rigidity is rare , since the damage to the brain centers involved in it are lethal.

However decorticate rigidity can be caused by bleeding in the internal capsule which causes UMNL (damage to upper motor neurons) .

Typical features in decorticated man consist of:

- Full extension of the legs
- Arm lying across the chest
- Semiflexoin at the elbow
- Slight pronation of forearm
- Flexion of wrist and fingers
    - 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*

Decorticate posture results from damage to one or both corticospinal tracts. In this posture, the arms are adducted and flexed, with the wrists and fingers flexed on the chest. The legs are stiffly extended and internally rotated, with plantar flexion of the feet.

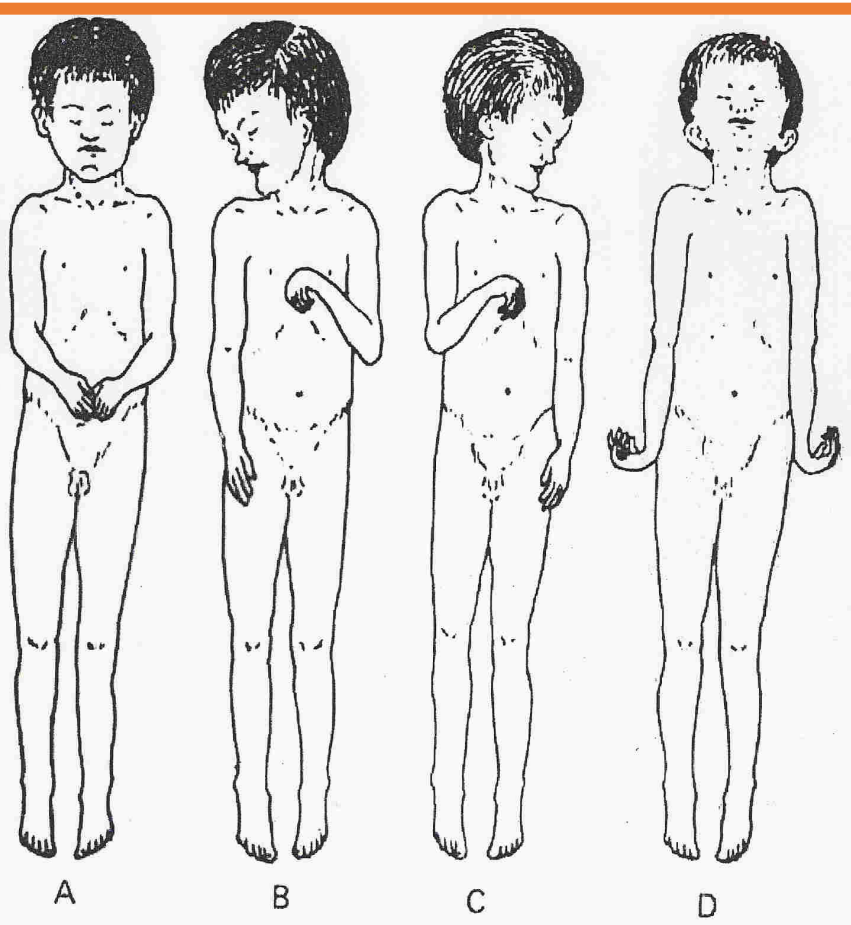

Figure 12–7. Human decorticate rigidity ***(A–C)*** and true decerebrate rigidity ***(D).*** In ***A*** the patient is lying supine with the head unturned. In ***B*** and ***C,*** the tonic neck reflex patterns produced by turning of the head to the right or left are shown. (Reproduced, with permission, from Fulton JF [editor]: *Textbook of Physiology,* 17th ed. Saunders, 1955.)

- 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

- Reflexes that are lost/absent
- (1) Placing Reaction , Hopping Reaction
- (2) Visual righting reflex
- Reflexes that are retained /still present (i.e., reflexes the do not depend primarily on cerebral cortex :
- (1) Tonic Labyrinthine reflexes
- (2) Tonic Neck Reflexes
- (3) Other Righting Reflexes

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

THANK YOU