Spinal Reflexes
Reflex Arc

A Reflex Arc Shows How Neuron Types Work Together.

The afferent and efferent fibers often pass in the same nerve.
Organization of Spinal Cord for Motor Functions

- **Anterior Motor Neuron**
  - Alfa Motor Neuron
  - Gamma Motor Neuron

- **Interneuron**

- **Renshaw Cells (inhibitory)**
Figure. Muscle spindle organ.

1. Afferent input from sensory endings of muscle spindle fiber
2. Alpha motor neuron output to regular skeletal-muscle fiber
3. Gamma motor-neuron output to contractile end portions of spindle fiber
4. Descending pathways coactivating alpha and gamma motor neurons

Relaxed muscle; spindle fiber sensitive to stretch of muscle
Contracted muscle in hypothetical situation of no spindle coactivation; slackened spindle fiber not sensitive to stretch of muscle
Contracted muscle in normal situation of spindle coactivation; contracted spindle fiber sensitive to stretch of muscle
Static and Dynamic Responses

- Static ---- Primary and secondary
- Dynamic ------ Primary
Brain Area to Control gamma motor neurons

- Bulboreticular Facilitatory Region of Brain Stem
- Secondary from Cerebellum, Basal Ganglia and Cerebral Cortex
INHIBITORY AREAS FROM THE CEREBRAL CORTEX (1,2), CEREBELLUM (3) AND RETICULAR FORMATION (4)

α -γ link

α MOTOR NEURONE ↔ γ MOTOR NEURONE

STRETCH REFLEX

Background for movement/postural reflexes

STIMULATORY AREAS FROM RETICULAR FORMATION (5) & CEREBELLUM (6) DISCHARGE SPONTANEOUSLY
Functions of Muscle Spindle

- Receptor Organ for Stretch Reflex
- Static – Maintenance of Muscle tone
- Dynamic – Stretch Reflex (Clinical Application)
- Damping Action – Soothens muscle contraction during running / walking and prevents oscillation or jerkiness of body movements
- Stabilises body positions during tense actions
Golgi Tendon

Increased Tension in muscle

Stimulation of golgi tendon

Inhibitory interneurons in spinal cord

Inhibition of muscle contraction
Muscle Sensory Receptors
Withdrawal Reflex

1 Sensory receptor in skin

2 Afferent pathway

3 Integrating center

4 Efferent pathway

5 Effector organs

Peripheral nervous system

Central nervous system

Stimulus

Biceps (flexor) contracts

Triceps (extensor) relaxes

Hand withdrawn

Response

Dorsal Root

Interneuron

To Brain

Ventral root
Flexor reflex, crossed extensor reflex, and reciprocal inhibition
Reflexes of posture and locomotion

- Positive supportive reaction
Reflexes of posture and locomotion

- Cord Righting Reflex
Reflexes of posture and locomotion

**Stepping and walking movements**

*Rhythmical stepping movement of a single limb*

*Reciprocal stepping of opposite limbs*

*Diagonal stepping of all four limbs*

*Galloping reflex*
Other Spinal reflexes

- Scratch Reflex
- Spinal cord reflexes that cause muscle spasm
  - *Muscle spasm resulting from a Broken Bone*
  - *Abdominal muscle spasm in peritonitis*
  - *Muscle cramps*
- Autonomic reflexes in the spinal cord
THE MASS REFLEX

- Spasm in flexor muscles
- Evacuation of bladder and colon
- Rise in arterial pressure
- Profuse sweating
SPINAL SHOCK

- Blood Pressure
- Reflexes
- Bladder and Colon evacuation