

Reflex Activity

■ DEFINITION AND SIGNIFICANCE OF REFLEXES

Reflex activity is the response to a peripheral nervous stimulation that occurs without our consciousness. It is a type of **protective mechanism** and it protects the body from irreparable damages.

For example, when hand is placed on a hot object, it is withdrawn immediately. When a bright light is thrown into the eyes, eyelids are closed and pupil is constricted to prevent the damage of retina by entrance of excessive light into the eyes.

■ REFLEX ARC

Reflex arc is the anatomical nervous pathway for a reflex action. A simple reflex arc includes five components (Fig. 142.1).

1. Receptor

Receptor is the **end organ**, which receives the stimulus. When receptor is stimulated, impulses are generated in afferent nerve.

2. Afferent Nerve

Afferent or **sensory nerve** transmits sensory impulses from the receptor to center.

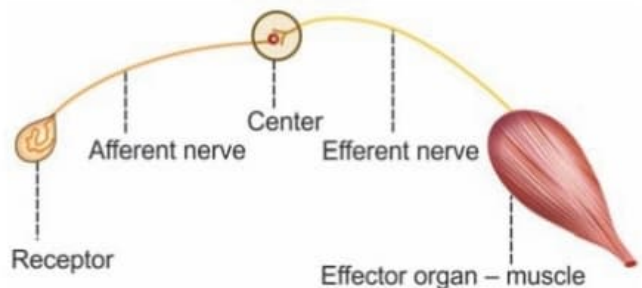


FIGURE 142.1: Simple reflex arc

3. Center

Center receives the sensory impulses via afferent nerve fibers and in turn, it generates appropriate motor impulses. Center is located in the brain or spinal cord.

4. Efferent Nerve

Efferent or **motor nerve** transmits motor impulses from the center to the effector organ.

5. Effector Organ

Effector organ is the structure such as muscle or gland where the activity occurs in response to stimulus.

Afferent and efferent nerve fibers may be connected directly to the center. In some places, one or more

neurons are interposed between these nerve fibers and the center. Such neurons are called **connector neurons** or **internuncial neurons** or **interneurons**.

■ CLASSIFICATION OF REFLEXES

Reflexes are classified by six different methods depending upon various factors. Different methods of classification are listed in Box 142.1.

BOX 142.1: Different methods to classify reflexes

Classification of reflexes

1. Depending upon whether inborn or acquired
2. Depending upon situation – anatomical classification
3. Depending upon purpose – physiological classification
4. Depending upon number of synapse
5. Depending upon whether visceral or somatic
6. Depending upon clinical basis

neurons are interposed between these nerve fibers and the center. Such neurons are called **connector neurons** or **internuncial neurons** or **interneurons**.

■ CLASSIFICATION OF REFLEXES

Reflexes are classified by six different methods depending upon various factors. Different methods of classification are listed in Box 142.1.

BOX 142.1: Different methods to classify reflexes

Classification of reflexes

1. Depending upon whether inborn or acquired
2. Depending upon situation – anatomical classification
3. Depending upon purpose – physiological classification
4. Depending upon number of synapse
5. Depending upon whether visceral or somatic
6. Depending upon clinical basis

■ 1. DEPENDING UPON WHETHER INBORN OR ACQUIRED REFLEXES

i. Inborn Reflexes or Unconditioned Reflexes

Unconditioned reflexes are the **natural reflexes**, which are present since the time of birth, hence the name inborn reflexes. Such reflexes do not require previous learning, training or conditioning. Best example is the secretion of saliva when a drop of honey is kept in the mouth of a newborn baby for the first time. The baby does not know the taste of honey, but still saliva is secreted.

ii. Acquired Reflexes or Conditioned Reflexes

Conditioned or acquired reflexes are the reflexes that are developed **after conditioning** or **training**. These reflexes are not inborn but, acquired after birth. Such reflexes need previous learning, training or conditioning. Example is the secretion of saliva by sight, smell, thought or hearing of a known edible substance.

■ 2. DEPENDING UPON SITUATION – ANATOMICAL CLASSIFICATION

In this method, reflexes are classified depending upon the situation of the center.

i. Cerebellar Reflexes

Cerebellar reflexes are the reflexes which have their center in **cerebellum**.

ii. Cortical Reflexes

Cortical reflexes are the reflexes that have their center in **cerebral cortex**.

iii. Midbrain Reflexes

Midbrain reflexes are the reflexes which have their center in **midbrain**.

iv. Bulbar or Medullary Reflexes

Bulbar or medullary reflexes are the reflexes which have their center in **medulla oblongata**.

v. Spinal Reflexes

Reflexes having their center in the spinal cord are called spinal reflexes. Depending upon the segments involved, spinal reflexes are divided into three groups:

- a. Segmental spinal reflexes
- b. Intrasegmental spinal reflexes
- c. Suprasegmental spinal reflexes.

■ 3. DEPENDING UPON PURPOSE – PHYSIOLOGICAL CLASSIFICATION

In this method, reflexes are classified depending upon the purpose (**functional significance**).

i. Protective Reflexes or Flexor Reflexes

Protective reflexes are the reflexes which protect the body from **nociceptive (harmful) stimuli**. These reflexes are also called **withdrawal reflexes** or flexor reflexes. Protective reflexes involve flexion at different joints hence the name flexor reflexes.

ii. Antigravity Reflexes or Extensor Reflexes

Antigravity reflexes are the reflexes that protect the body against **gravitational force**. These reflexes are also called the extensor reflexes because, the extensor muscles contract during these reflexes resulting in extension at joints.

■ 4. DEPENDING UPON THE NUMBER OF SYNAPSE

Depending upon the number of synapse in reflex arc, reflexes are classified into two types:

i. Monosynaptic Reflexes

Reflexes having only **one synapse** in the reflex arc are called monosynaptic reflexes. Stretch reflex is the best example for monosynaptic reflex and it is elicited due to the stimulation of muscle spindle.

ii. Polysynaptic Reflexes

Reflexes having **more than one** synapse in the reflex arc are called polysynaptic reflexes. Flexor reflexes (withdrawal reflexes) are the polysynaptic reflexes.

■ 5. DEPENDING UPON WHETHER SOMATIC OR VISCERAL REFLEXES

i. Somatic Reflexes

Somatic reflexes are the reflexes, for which the reflex arc is formed by **somatic nerve fibers**. These reflexes involve the participation of skeletal muscles. And there may be flexion or extension at different joints during these reflexes.

ii. Visceral or Autonomic Reflexes

Visceral or autonomic reflexes are the reflexes, for which at least a part of reflex arc is formed by **autonomic nerve fibers**. These reflexes involve participation of smooth muscle or cardiac muscle. Visceral reflexes include pupillary reflexes, gastrointestinal reflexes, cardiovascular reflexes, respiratory reflexes, etc.

Some reflexes like swallowing, coughing or vomiting are considered as visceral reflexes. However, these reflexes involve some participation of skeletal muscles also.

■ 6. DEPENDING UPON CLINICAL BASIS

Depending upon the clinical basis, reflexes are classified into four types:

- i. Superficial reflexes
- ii. Deep reflexes

- iii. Visceral reflexes
- iv. Pathological reflexes.

■ SUPERFICIAL REFLEXES

Superficial reflexes are the reflexes, which are elicited from the surface of the body. Superficial reflexes are of two types: mucus membrane reflexes and skin reflexes.

■ 1. MUCOUS MEMBRANE REFLEXES

Mucous membrane reflexes arise from the mucus membrane. Details of mucus membrane reflexes are listed in Table 142.1.

■ 2. CUTANEOUS REFLEXES OR SKIN REFLEXES

Cutaneous reflexes are elicited from skin by the stimulation of cutaneous receptors. Details of these reflexes are given in Table 142.2.

■ DEEP REFLEXES

Deep reflexes are elicited from deeper structures beneath the skin like tendon. These reflexes are otherwise known as **tendon reflexes**. Details of these are given in Table 142.3.

■ VISCERAL REFLEXES

Visceral reflexes are the reflexes arising from **pupil** and **visceral organs**. Other details of visceral reflexes are already given above.

TABLE 142.1: Superficial mucous membrane reflexes

Reflex	Stimulus	Response	Afferent Nerve	Center	Efferent Nerve
1. Corneal reflex	Irritation of cornea	Blinking of eye (closure of eyelids)	V cranial nerve	Pons	VII cranial nerve
2. Conjunctival reflex	Irritation of conjunctiva	Blinking of eye	V cranial nerve	Pons	VII cranial nerve
3. Nasal reflex (sneezing reflex)	Irritation of nasal mucus membrane	Sneezing	V cranial nerve	Motor nucleus of V cranial nerve	X cranial nerve and upper cervical nerves
4. Pharyngeal reflex	Irritation of pharyngeal mucus membrane	Retching or gagging (opening of mouth)	IX cranial nerve	Nuclei of X cranial nerve	X cranial nerve
5. Uvular reflex	Irritation of uvula	Raising of uvula	IX cranial nerve	Nuclei of X cranial nerve	X cranial nerve

TABLE 142.2: Superficial cutaneous reflexes

Reflex	Stimulus	Response	Center – spinal segments involved
1. Scapular reflex	Irritation of skin at the interscapular space	Contraction of scapular muscles and drawing in of scapula	C5 to T1
2. Upper abdominal reflex	Stroking the abdominal wall below the costal margin	Ipsilateral contraction of abdominal muscle and movement of umbilicus towards the site of stroke	T6 to T9
3. Lower abdominal reflex	Stroking the abdominal wall at umbilical and iliac level	Ipsilateral contraction of abdominal muscle and movement of umbilicus towards the site of stroke	T10 to T12
4. Cremasteric reflex	Stroking the skin at upper and inner aspect of thigh	Elevation of testicles	L1, L2
5. Gluteal reflex	Stroking the skin over glutei	Contraction of glutei	L4 to S1,2
6. Plantar reflex	Stroking the sole	Plantar flexion and adduction of toes	L5 to S2
7. Bulbocavernous reflex	Stroking the dorsum of glans penis	Contraction of bulbocavernosus	S3, S4
8. Anal reflex	Stroking the perianal region	Contraction of anal sphincter	S4, S5

TABLE 142.3: Deep reflexes

Reflex	Stimulus	Response	Center – spinal segments involved
1. Jaw jerk	Tapping middle of the chin with slightly opened mouth	Closure of mouth	Pons – V cranial nerve
2. Biceps jerk	Percussion of biceps tendon	Flexion of forearm	C5, C6
3. Triceps jerk	Percussion of triceps tendon	Extension of forearm	C6 to C8
4. Supinator jerk or radial periosteal reflex	Percussion of tendon over distal end (styloid process) of radius	Supination and flexion of forearm	C7, C8
5. Wrist tendon or finger flexion reflex	Percussion of wrist tendons	Flexion of corresponding finger	C8, T1
6. Knee jerk or patellar tendon reflex	Percussion of patellar ligament	Extension of leg	L2 to L4
7. Ankle jerk or Achilles tendon reflex	Percussion of Achilles tendon	Plantar flexion of foot	L5 to S2

Following are the visceral reflexes:

1. Pupillary reflexes
2. Oculocardiac reflex
3. Carotid sinus reflex.

■ PUPILLARY REFLEXES

Pupillary reflexes are the reflexes in which, the size of pupil is altered.

Pupillary reflexes are:

- i. Light reflex

- ii. Accommodation reflex
- iii. Cilio-spinal reflex.

i. Light Reflex

When retina of the eye is stimulated by a sudden flash of light, **constriction of pupil occurs**. It is called light reflex.

Light reflex of two types:

- a. Direct light reflex, in which stimulation of retina in one eye by flash of light causes constriction of pupil in the same eye

- b. Indirect or consensual light reflex, in which stimulation of retina in one eye by flash of light causes simultaneous constriction of pupil in the other eye also.

ii. *Accommodation Reflex*

While eyes are fixed on a distant object and if another object is brought in front of the eye (near the eye) the vision shifts from **far object** to **near object**. During that time some changes occur in the eyes.

Changes during accommodation reflex are:

- a. Constriction of pupil
- b. Convergence of eyeball
- c. Increase in anterior curvature of lens.

iii. *Ciliospinal Reflex*

Ciliospinal reflex is the **dilatation of pupil** due to stimulation of skin over the neck.

More details of pupillary reflexes are given in Chapter 169.

■ **OCULOCARDIAC REFLEX**

Oculocardiac reflex is the reflex, in which **heart rate decreases** due to the pressure applied over eyeball.

■ **CAROTID SINUS REFLEX**

Carotid sinus reflex is the **decrease in heart rate** and blood pressure caused by pressure over carotid sinus in neck due to tight collar.