THE REFLEXES

The investigation of the reflexes is often considered to be the most important part of the neurologic examination. The testing of the reflexes is the most objective procedure of the neurologic examination. Reflex activity is essential to the normal functions of the human body. All involuntary and many voluntary acts are reflex in nature.

A reflex is an invariable adaptive response to the stimulation of a sense organ, which involves the use of a center of adjustment and of the conductors necessary to connect this center with the appropriate receptor and effector apparatus. By neurological examination mainly involuntary reflexes are investigated. An intact sensory system and an intact motor

system are needed for a normal reflex response, and knowledge of both sensory and motor functions is necessary to an understanding of reflex action.

The stimulus is received by the ***receptor***, which may be a sensory ending in the skin, mucous membranes, muscle, tendon, or periosteum etc. The stimulation of the receptor initiates an impulse that is carried along ***the afferent (sensory) nervous fibers***, and then is transmitted to the CNS. There a synapse takes place with **the *intercalated neuron***, which relays the impulse to the center of adjustment, the cell body of the ***efferent neuron***. The neuraxis of the efferent neuron, transmits the impulse to the ***effector*** (the cell, muscle, gland, or blood vessel that then responds). A disturbance in function of any of the above parts of the ***reflex arc*** will cause a break in the reflex arc and a consequent decrease or loss of the reflex.

Some hundreds of reflexes have been identified; only the more important ones will be described.

The muscle stretch (proprioceptive or deep) reflexes

The muscle stretch reflexes are those that are elicited in response to application of the stimulus to either tendons or periosteum, or occasionally to bones, joints, fascia, or aponeurotic structures. They are often incorrectly called tendon or periosteal reflexes. It is the muscle stretch that elicits the reflex; the tendon is a convenient location to apply the stimulus.

Because the stimulus is mediated through the deeper sense organs such as the neuromuscular and neurotendinous spindles, they may be referred to as the *proprioceptive (or deep) reflexes*.

The proprioceptive reflexes are best tested by the use of a ***rubber percussion hammer***.

The stimulus should be quick and direct, and should be a threshold one, and no greater than necessary. The patient should be comfortable and relaxed. The part of the body to be tested should be in a position for optimal muscular response. In order to compare the reflexes on the two sides of the body, the position of the extremities should be symmetric. Reflexes may be classified as normal, absent, sluggish (diminished), and exaggerated.

The response should always be compared on the two sides of the body; unequal reflexes may be as significant as either increased or diminished reflexes.

The Orbicularis Oculi (blinking) Reflex. Percussion at the outer aspect of the supraorbital area and other kinds of irritation is followed by a reflex contraction of this muscle, with resulting closing of the eye. The response is usually bilateral. The afferent portion of the arc may be carried through the trigeminal nerve; the efferent impulses pass through the facial nerve, and the reflex center is in the pons.

The Jaw (Masseter or Mandibular Reflex). To elicit the jaw reflex the examiner places his index finger over the middle of the patient's chin, holding the mouth slightly opened and the jaw relaxed. Then he taps his finger with the reflex hammer. The response is a contraction of the masseter and temporal muscles, causing a sudden closing of the mouth. The afferent impulses of this reflex are carried through the sensory portion of the trigeminal nerve, and the efferent impulses through its motor portion; the reflex center is in the pons.

Proprioceptive reflexes reflexes of the upper extremities

The biceps, triceps and brachioradialis reflexes are the most important muscle stretch reflexes in the upper extremity.

The Biceps Reflex. The arm is held in a relaxed position, with the forearm midway between flexion and extension and in slight pronation. The examiner places his thumb or finger over the biceps tendon and taps the thumb with a reflex hammer. The major response is a contraction of the biceps muscle

with flexion of the forearm. The sensory supply of this reflex is through the midcervical nerves, and the motor supply to the biceps is through the musculocutaneous nerve. The reflex center is at the C**V**-C**VI** segments.

The Triceps Reflex is elicited by tapping the triceps tendon just above its insertion on the olecranon process of the ulna. The arm is held midway between flexion and extension, and it may be rested on the examiner's hand or on the patient's thigh. The response is one of

contraction of the triceps muscle, with extension of the forearm. The sensory and motor innervations are through the radial nerve, and the center is in the lower cervical portion of the spinal cord (C**VI**-C**VIII)**.

The Brachioradialis (Radial Periosteal or Supinator) Reflex. If the styloid process of the radius is tapped while the forearm is in semi-flexion and semipronation, there will be flexion of the forearm, together with supination. The supination is more marked if the forearm has been extended and pronated, but there is less flexion. If the reflex is exaggerated there is associated flexion of the wrist and fingers, with adduction of the forearm. The innervation of this reflex is through the radial nerve and spinal segments C**V**-C**VI**.

Proprioceptive reflexes reflexes of the lower extremities

The Patellar (Quadriceps) Reflex. The patellar, or quadriceps, reflex, usually called the *knee jerk*, is characterized by contraction of the quadriceps femoris muscle, with resulting extension of the leg, in response to a stimulus directed toward the patellar tendon. The patellar reflex is innervated by the femoral nerve and spinal segments **LII-LIV**.

This reflex may be elicited with the patient seated in a chair with his feet resting on the floor or with the patient lying in bed or by having the patient sit with one leg crossed over the other and tapping the patellar tendon of the superior leg. Reinforcement of the patellar reflexes may be carried out according to the method of Jendrassik: on testing reflexe the patient is asked to hook the flexed fingers of the two hands together, placing the palmar surfaces of the fingers of one hand against the palmar surfaces of the other, and to attempt to pull them apart at the time the reflex is being stimulated.

The Achilles (Triceps Surae) Reflex. The Achilles, or triceps surae, reflex, or the ankle jerk, is obtained by tapping the Achilles tendon just above its innervation on the posterior surface of the calcaneus. This is followed by contraction of the posterior crural muscles, the gastrocnemius, soleus, and plantaris, with resulting plantar flexion of the foot at the ankle. If the patient is seated or is lying in bed, the thigh should be moderately abducted and rotated externally, the knee should be flexed, and the foot should be in moderate inversion; the examiner should place one hand under the foot to produce moderate dorsiflexion at the ankle. If it cannot be elicited in this manner, the patient should be asked to kneel on his knees on a chair, while the feet project at right angles; the Achilles tendons are percussed while the patient is in this position. The Achilles reflex is innervated by the tibial nerve and **LV** and **SI, SII** spinal segments.

Under normal circumstances the reflexes should be equal on the two sides. The pathologic conditions in which various changes of relexes occur are discussed in the following sections.

Diminution to Absence of the Muscle Stretch Reflexes

In hypoactivity the response varies from a diminished or sluggish one to complete absence of the reflex. Diminution of the reflexes results from an interference with the conduction of the impulse through the reflex arc, and may be associated with dysfunction of the receptor, afferent pathway, intercalated neuron, motor unit, efferent pathway, or effector

apparatus.

Hyperactivity of the Muscle Stretch Reflexes

Hyperactivity of the muscle stretch reflexes is characterized by decrease in the reflex threshold, increase in the speed of response, exaggeration of the vigour and range of movement, prolongation of muscular contraction, extension of the reflexogenous zone. The muscle stretch reflexes are increased with lesions of the corticospinal or pyramidal system. These changes are due to involvement of a variety of structures in the descending motor pathways at cortical, subcortical, midbrain and brain stem levels as well as in the spinal cord. The flexor reflexes are exaggerated to a greater degree in the upper extremities, and the

The superficial (cutaneous) reflexes

The superficial reflexes are those that are elicited in response to the application of a stimulus to either the skin or mucous membrane, they are sometimes known as exteroceptive reflexes.

The Corneal Reflex. To elicit the corneal reflex, the examiner touches the cornea lightly with a wisp of cotton or a piece of a thin paper to avoid irritating the cornea. In response to this stimulus there is a blinking, or closing of the ipsilateral eye, the direct corneal reflex, and also a closing of the opposite eye, the consensual corneal reflex. The afferent portion of the reflex arc is mediated by the ophthalmic division of the trigeminal nerve, whereas the efferent or motor response is a function of the facial nerve. The reflex center is in the pons.

The pharyngeal, or gag, reflex is elicited by applying a stimulus, such as a tongue blade or an applicator, to the posterior pharyngeal wall, tonsillar regions, faucial pillars, or even the base of the tongue. If the reflex is present, there will be elevation and constriction of the pharyngeal musculature. The afferent impulses of the reflex arc are primarily carried through the glossopharyngeal, the efferent elements primarily through the glossopharyngeal and vagus nerve. The reflex center is in the medulla.

The palatal or uvular reflex is tested by stimulating the lateral and inferior surface of the uvula, or soft palate, with a tongue blade or a cotton applicator. Elevation of the soft palate and retraction of the uvula occur simultaneously. The center for this reflex is also in the medulla. Both the sensory and the motor portions of the reflex arc is carried through the vagus and glossopharyngeal nerves.

The superficial abdominal reflexes

Gentle stroking of the abdomen or scratching it with a blunt object is followed by homolateral contraction of the abdominal muscles and retraction or deviation of the linea alba and umbilicus toward the area stimulated. These reflexes should be tested with the patient recumbent and the abdominal wall thoroughly relaxed.

The Upper Abdominal Reflex is elicited by stimulating the skin of the upper abdominal quadrants, usually in a diagonal fashion, downward and outward from the tip of the sternum. This reflex is innervated by the intercostal nerves from **ThVI-ThVIII**.

The Middle Abdominal Reflex. Stimulation of the skin of the abdomen at the level of the umbilicus, either by a horizontal stimulus, starting externally and proceeding medially is followed by a lateral deviation of the linea alba and umbilicus. This reflex is innervated by the intercostal nerves from **ThIX-ThX**.

The Lower Abdominal Reflex. This is elicited by stimulating the skin of the lower abdominal quadrants, either diagonally in an upward and outward direction from the region of the symphysis pubis. There is a contraction of the abdominal muscles and a diagonal deviation of the umbilicus toward the site of the stimulation. This reflex is innervated by the lower intercostal and the iliohypogastric and ilioinguinal nerves **ThXI-ThXII**.

These reflexes may be difficult to obtain or absent in obese individuals and those with relaxed abdominal walls, and in women who have borne children. In pathology the absence of superficial abdominal reflexes is a significant finding.

The Cremasteric Reflex is elicited by stroking the skin on the upper, inner aspect of the thigh, from above downward, with a blunt point, or by pricking or lightly pinching the skin in this area. The response consists of a contraction of the cremasteric muscle with homolateral elevation of the testicle. This reflex may be absent in elderly males, in individuals who have a hydrocele or varicocele, and in those who have had orchitis or epididymitis. The innervation is through ilioinguinal and genitofemoral nerves **LI-LII**.

The Plantar Reflex. In the normal individual, stimulation of the plantar surface of the foot is followed by plantar flexion of the toes. It innervated by the **LV-SII** segments by means of the tibial nerve.

The Superficial Anal Reflex consists of a contraction of the external sphincter in response to stroking or pricking the skin or mucous membrane in the perianal region. This reflex is innervated by the inferior hemorrhoidal nerve **SIV-SV**.