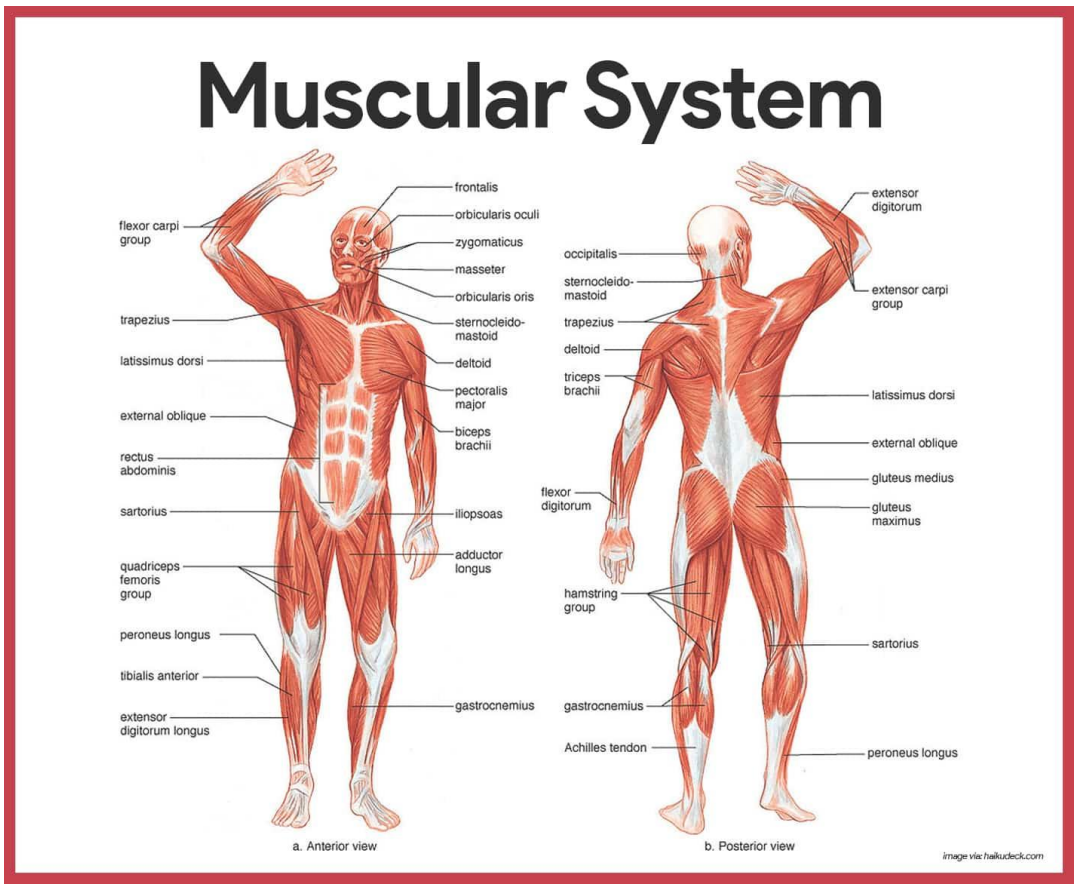
THE MUSCULAR SYSTEM



Functions of the Muscular System

Muscles hold the body erect and make movements possible.

Muscle movement generates nearly 85% of the heat that keeps the body warm.

Muscles move food through the digestive system.

Muscle movements aid the flow of blood through veins as it returns to the heart.

Muscle action moves fluids through ducts and tubes associated with other body systems.

Structures of the Muscular System

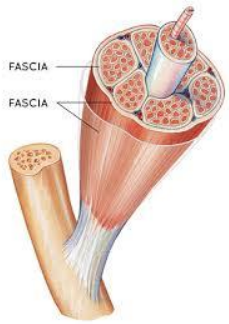
The body has more than 600 muscles that make up more than 40% of the body's weight. These muscles are made up of fibres, covered with fascia, and attached to bones by tendons.

Muscle Fibers

The muscles are composed of long, slender cells known as muscle fibres.
Each muscle consists of a group of fibres held together by connective tissue and enclosed in a fibrous sheath.

Fascia

Fascia is the sheet or band of fibrous connective tissue that covers, supports, and separates muscles.



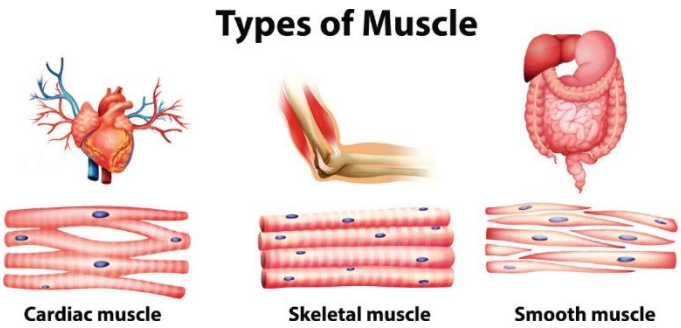
Tendons

A tendon is a narrow band of nonelastic, dense, fibrous connective tissue that attaches a muscle to a bone. For example, the Achilles tendon attaches the gastrocnemius muscle (the major muscle of the calf of the leg) to the heel bone.

Aponeurosis

An aponeurosis is a flat fibrous sheet of connective tissue that is very similar to a tendon; however, aponeurosis attaches a muscle to bone or other tissues.

Types of Muscle Tissue



The three types of muscle tissue are skeletal, smooth, and cardiac. These types are described according to their appearance and function.

Skeletal muscles

Skeletal muscles attach to the bones of the skeleton and are the muscles that make possible body motions such as walking and smiling. Skeletal muscles are also known as striated muscles because dark and light bands in the muscle fibres create a striped (striated) appearance. Skeletal muscles are also known as voluntary muscles because we have conscious (voluntary) control over these muscles.

Smooth muscles

Smooth muscles are located in the walls of internal organs such as the digestive tract, blood vessels, and ducts leading from glands. Their function is to move and control the flow of fluids through these structures.

Smooth muscles are also known as unstriated muscles because they do *not* have the dark and light bands that produce the striped (striated) appearance seen in striated muscles.

Smooth muscles are also known as involuntary muscles because they are under

the control of the autonomic nervous system and are not under voluntary control.

Smooth muscles are also known as visceral muscles because they are found in the large internal organs (except the heart) and in hollow structures as the digestive and urinary systems.

Cardiac Muscle

Cardiac muscle, also known as myocardial muscle, forms the muscular wall of the heart. This muscle is also known as the myocardium. A cardiac muscle is a specialized tissue that is like a striated muscle in its appearance, but like a smooth muscle in its action. It is the contraction and relaxation of this muscle that causes the heartbeat.

Characteristics of Muscles

Kinesiology is the study of muscular activity and the resulting movement of body parts.

Antagonistic Muscle Pairs

The muscles of the body are arranged in antagonistic pairs. Antagonistic means to work in opposition to each other. In an antagonistic pair, one muscle moves in one direction and the other muscle moves in the opposite direction.

Muscles are made up of specialized cells that can change length or shape by contracting and relaxing. It is these contrasting actions that make motion possible.

Contraction is the tightening of a muscle. As the muscle contracts, it becomes shorter and thicker causing the belly (centre) of the muscle to enlarge. Relaxation occurs when a muscle returns to its original form. As the muscle relaxes it becomes longer and thinner and the belly is no longer enlarged. When one muscle of a pair contracts, the other usually relaxes.

Muscle tone, also known as tonus, is the normal state of balanced muscle tension (contraction and relaxation) that is required to hold the body in an awake position.

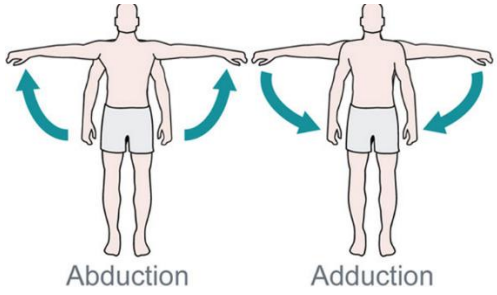
Muscle Innervation

Muscle innervation is the stimulation of the muscle by an impulse transmitted by a motor nerve. This stimulation causes the muscle to contract. When the stimulation stops, the muscle relaxes.

Muscle Motions

Abduction process of moving away from the midline

Adduction process of moving toward the midline.



Flexion (bending) process of decreasing the angle as in bending a joint

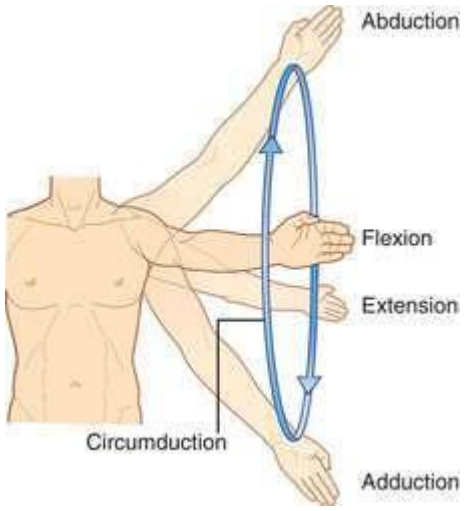
Extension (straightening) process of increasing the angle as in straightening a joint.

Elevation raises a body part

Depression lowers a body part.

Rotation turns a bone on its own axis

Circumduction turns at the far end.

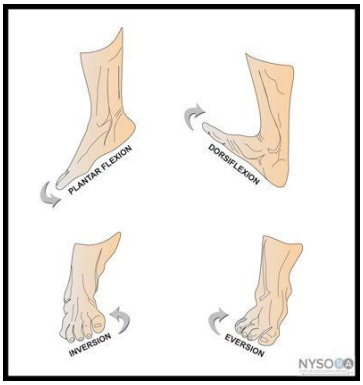


Supination turns the palm upward or forward.

Pronation turns the palm downward or backwards.

Dorsiflexion bends the foot upward at the ankle.

Plantar flexion bends the foot downward at the ankle.



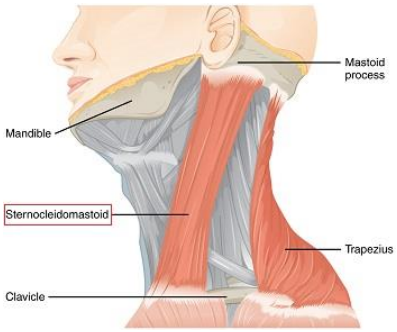
How Muscles are Named

Some muscles are named by joining the name of the place of origin to the name of the place of insertion.

Muscle origin is the place where the muscle begins (originates). This is the more fixed attachment and/or the end *of* the muscle nearest the midline of the body.

Muscle insertion is the place where the muscle ends (inserts). It is the more moveable end and/or the portion of the muscle farthest from the midline of the body.

For example, the sternocleidomastoid muscle that helps flex the neck and rotate the head is named for its origin and insertion. This muscle originates near the midline from the sternum (breastbone) and clavicle (collar bone). It inserts away from the midline into the mastoid process of the temporal bone (located just behind the ear).



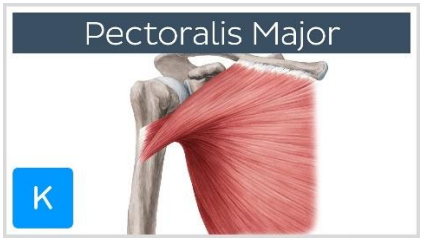
Muscles Named for Their Action

Some muscles are named for their action such as flexing or extending.

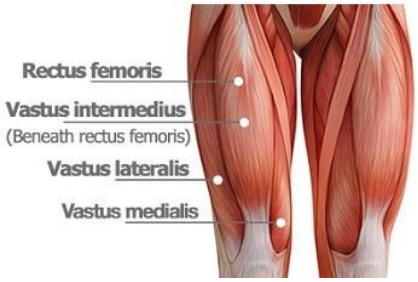
For example, the flexor carpi muscles work with the extensor carpi muscles to make possible the flexion and extension motions of the wrist.

Muscles Named for Their Location

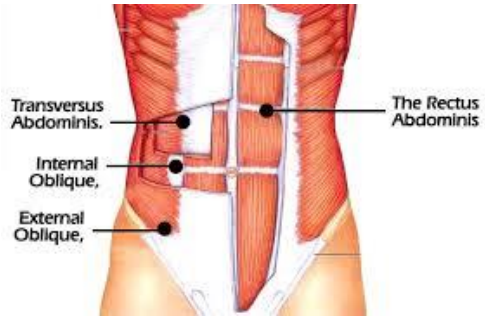
Some muscles are named for their location on the body or the organ they are near. For example, the pectoralis major is an important muscle of the chest and pectoral means relating to the chest.



Other muscles, such as vastus lateralis and vastus medialis, indicate their location by including lateral (toward the side) and medial (toward the midline) in their names.



Some muscles show location by including external and internal in their names. For example, the external oblique and internal oblique muscles.

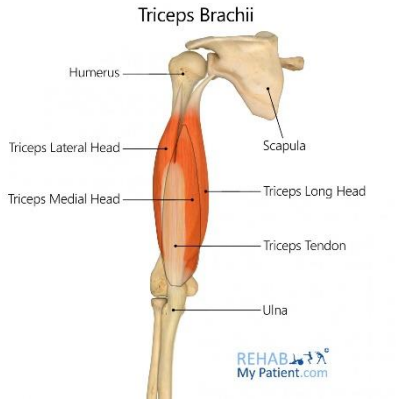


Muscles Named for Number of Divisions

Muscles may be named according to the number of divisions forming them. For example, the biceps brachii, also known as the biceps muscle, is formed from two divisions. This is the muscle of the anterior upper arm that flexes the elbow.

The triceps brachii, also known as the triceps muscle, is formed from three divisions. This is the muscle of the posterior upper arm that extends the elbow.

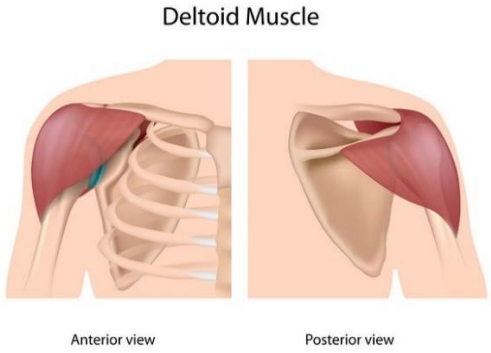
The quadriceps femoris is formed from four muscle divisions (quadri- means four and ceps means head). This large muscle, which is located on the anterior thigh, assists in extending the femur.



Muscles Named for their Size

Some muscles are named because they are broad or narrow, large or small. For example, the gluteus maximus is the largest muscle of the buttock.

Other muscles are named because they are shaped like a familiar object. For example, the deltoid muscle, which forms the muscular shoulder cap, is shaped like an inverted triangle or the Greek letter delta.



Characteristic of muscle	Example	Meaning
Shape	• musculus deltoideus (deltoid) • musculus trapezius (trapezoid) • platysma (plat) • serratus anterior (serrare)	• triangular, Δ • four-sided • flat • saw
Size	• vastus lateralis (vastus) • pectoralis major (major) • pectoralis minor (minor) • gluteus maximus (maximus) • gluteus minimus (minimus), flexor digiti minimi • longus capitus (longus) • abductor policis brevis (brevis)	• great • large • small • greatest, largest • least, smallest • long • short

Muscle fiber orientation	▪ transverse
	  ▪ musculus transversus linguae
	▪ oblique
	▪ musculus obliquus externus abdominus
	▪ rectus
	  ▪ musculus rectus abdominis
	  ▪ superior rectus muscle
		▪ perpendicular to the midline
		
		to run diagonally at an angle or slanting
		
		▪ run parallel to the midline

Action	❖ flexor carpi radialis ❖ extensor indicis muscle ❖ supinator muscle (of the arm) ❖ pronator teres muscle ❖ levator angulus oris muscle ❖ depressor anguli oris muscle ❖ supraspinatus muscle (rotator cuff) ❖ abductor pollicis brevi s muscle ❖ adductor pollicis muscle ❖ pyloric sphincter muscle ❖ tensor fascia latae muscle	❖ flexors ❖ extensors ❖ supinators ❖ pronators ❖ levators ❖ depressors ❖ rotators ❖ abductors ❖ adductors ❖ sphincters ❖ tensor
Number of origins	biceps brachii muscle triceps brachii muscle quadriceps femoral muscle	2 points of origin 3 points of origin 4 points of origin
Origin and insertion	sternohyoid muscle	
Function	risorius muscle	risis “laugh”
Location	tibialis anterior muscle inferior superior - superspinatus medialis intermedius lateralis	 infra- supra- medial intermediate lateral

Medical Specialties Related to the Muscular System

An orthopaedic surgeon treats injuries and disorders involving bones, joints, muscles, and tendons.

A rheumatologist treats disorders that involve the inflammation of connective tissues including muscles.

A neurologist treats the cause of paralysis and similar muscular disorders in which there is a loss of function.

A specialist in sports medicine treats sports-related injuries of the bones, joints, and muscles.

Pathology of the Muscular System

Fibres, Fascia and Tendons

Fasciitis is inflammation of a fascia.

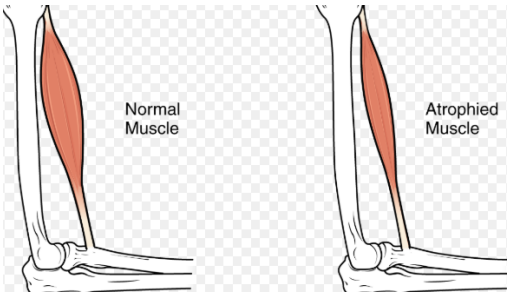
Tenalgia or **tenodynia** is pain in a tendon.

Tendinitis, also known as **tendonitis**, is an inflammation in the tendons caused by the excessive or unusual use of the joint.

Muscles

An **adhesion** is a band of fibrous tissue that holds structures together abnormally. They may form in muscles and internal organs as the result of an injury or surgery.

Muscle atrophy is a weakness and wasting away of muscle tissue. It may be caused by pathology or by disuse of the muscle over a long period of time.



Myalgia means muscle tenderness or pain.

Myolysis is the degeneration of muscle tissue.

Myositis is an inflammation of muscle tissue, especially skeletal muscles.

Polymyositis is a chronic, progressive disease affecting the skeletal muscles that is characterized by muscle weakness and atrophy.

Myomalacia is abnormal softening of muscle tissue.

Myorrhexis is the rupture of a muscle.

Myosclerosis is an abnormal hardening of muscle tissue.

Myocele is the protrusion of a muscle through its ruptured sheath or fascia.

Muscle Tone

Atonic means the lack of normal muscle tone.

Dystonia is a condition of abnormal muscle tone.

Hypertonia is a condition of excessive tone of the skeletal muscles with increased resistance of muscle to passive stretching.

Hypotonia is a condition of diminished tone of the skeletal muscles with decreased resistance of muscle to passive stretching.

Myotonia is the delayed relaxation of a muscle after a strong contraction.

Voluntary Muscle Movement

Ataxia is an inability to coordinate muscles in the execution of voluntary movement

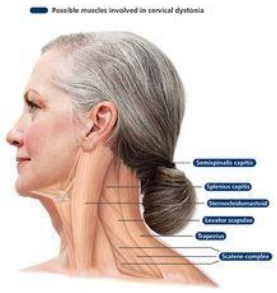
Dystaxia, also known as **partial ataxia**, is difficulty in controlling voluntary movement.

Contracture is an abnormal shortening of muscle tissues making the muscle resistant to stretching.

Intermittent claudication is a complex of symptoms including cramp like pain of the leg muscles caused by poor circulation and may be an indication of a larger cardiovascular problem.

A spasm, also known as a **cramp**, is a sudden, violent, involuntary contraction of a muscle or a group of muscles.

Spasmodic torticollis, also known as **wryneck**, is a stiff neck due to spasmodic contraction of the neck muscles that pull the head toward the affected side.



Muscle Function

Bradykinesia means extreme slowness in movement.

Dyskinesia means distortion or impairment of voluntary movement as in a tic or spasm.

Hyperkinesia, also known as hyperactivity, means an abnormally increased motor function or activity.

Hypokinesia is abnormally decreased motor function or activity.

Tardive dyskinesia is the late appearance of dyskinesia as a side effect of long-term treatment with certain antipsychotic drugs.

Myoclonus

Myoclonus is a spasm or twitching of a muscle or group of muscles.

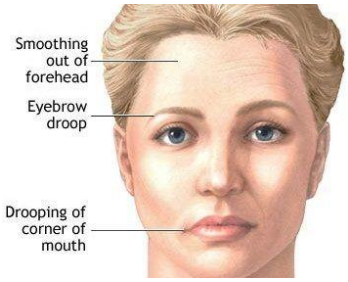
Nocturnal myoclonus is jerking of the limbs that may occur normally as a person is falling asleep.

Singultus, also known as hiccups, is the myoclonus of the diaphragm that causes the characteristic hiccup sound with each spasm.

Myasthenia Gravis

Myasthenia is muscle weakness from any cause.

Myasthenia Gravis (MG) is a chronic autoimmune disease in which the neuromuscular function is abnormal causing episodes of muscle weakness. MG most frequently affects the muscles that control eye movements, eyelids, chewing, swallowing, coughing, and facial expression. Ptosis, which is very common and may occur while the patient is reading or during long periods of driving, may be unilateral or bilateral.



Muscular Dystrophy

Muscular dystrophy is a group of inherited muscle disorders that cause muscle weakness without affecting the nervous system. The most common forms, which affect only males, are Duchenne's muscular dystrophy (DMD) and Becker's muscular dystrophy (BMD).

Duchenne muscular dystrophy (DMD) is a progressive form of muscular dystrophy that occurs primarily in males, though in rare cases may affect females. DMD causes progressive weakness and loss (atrophy) of skeletal and heart muscles. Early signs of DMD may include delayed ability to sit, stand, or walk and difficulties learning to speak. Muscle weakness is usually noticeable by 3 or 4 years of age and begins in the hips, pelvic area, upper legs, and shoulders. Children with DMD may have an unusual walk and difficulty running, climbing stairs, and getting up from the floor. DMD may also affect learning and memory, as well as communication and certain social-emotional skills. Muscle weakness worsens with age and progresses to the arms, legs and trunk. Most children with DMD use a wheelchair full time by age 13. Heart and respiratory muscle problems begin in the teen years and lead to serious, life-threatening complications.

Becker muscular dystrophy (BMD) is an inherited condition that causes progressive weakness and wasting of the skeletal and cardiac muscles. It primarily affects males. The age of onset and rate of progression can vary. In some cases, heart involvement (cardiomyopathy) is the first sign. BMD is very similar to Duchenne muscular dystrophy, except that in BMD, symptoms begin later and progress at a slower rate. The symptoms of Becker muscular dystrophy (BMD) may begin

anywhere from childhood to a person's early 20s. Muscle weakness often affects the legs and pelvis, and slowly gets worse. Over time, affected people begin to have difficulty walking, frequent falls, difficulty with muscle skills (such as running and jumping), and loss of muscle mass. Eventually, affected people require a wheelchair. Other symptoms of BMD may include cognitive problems, fatigue, loss of balance and coordination, problems breathing, and muscle weakness in the arms, neck and other areas of the body.

Fibromyalgia syndrome (FMS) is a chronic disorder of unknown cause characterized by widespread aching pain, tender points, and fatigue. This syndrome does not cause joint deformity, is not progressive and is not crippling.

Tender joints, which are abnormal localized areas of soreness, are important diagnostic indicators of FV. These points occur at predictable locations at the base of the neck, along the backbone, in front of the hip and elbow, and at the rear of the knee and shoulder.

Sport Injuries

A sprain is an injury to a joint such as an ankle, knee caused by overuse, a sprain frequently involves a stretched or torn ligament.

A strain is an injury to the body of the muscle or attachment of the tendon. Strains usually are associated with overuse injuries that involve a stretched or torn muscle or tendon attachment. Although these terms have slightly different meanings, they are frequently used interchangeably.

Achilles' tendinitis is a painful inflammation of the Achilles tendon caused by excessive stress being placed on the tendon.

Paralysis

Myoparesis is a weakness or slight paralysis of a muscle.

Hemiparesis means slight paralysis of one side of the body.

Paralysis is the loss of sensation and voluntary muscle movements through disease

or injury to its nerve supply. Damage may be either temporary or permanent. Paralysis is frequently caused by a spinal cord injury, also known as an SCI, that prevents nerve impulses from being carried below the level of the Injury.

Paraplegia is the paralysis of both legs and the lower part of the body. An individual affected with paraplegia is known as a paraplegic. An SCI below the cervical vertebrae results in paraplegia.

Quadriplegia is the paralysis of all four extremities. An SCI involving the cervical vertebrae causes quadriplegia. If the injury is above C5, it also affects respiration.

Hemiplegia is the total paralysis of one side of the body. This form of paralysis is usually associated with stroke or brain damage. Damage to one side of the brain causes paralysis on the opposite side of the body.