

CHAPTER 14: MUSCULAR SYSTEM

Building a Medical Terminology Foundation 2e by Kimberlee Carter; Marie Rutherford; and Connie Stevens

- 14.1 – Introduction to the Muscular System
- 14.2 – Anatomy (Structures) of the Muscular System
- 14.3 – Physiology (Function) of the Muscular System
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- References

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14.1 - Introduction to the Muscular System

Learning Objectives

- Identify the anatomy of the muscular system and describe the main functions of the muscular system
- Analyze, translate, and define medical terms and common abbreviations of the muscular system
- Practice the spelling and pronunciation of muscular system terminology
- Identify the medical specialties associated with the muscular system and explore common diseases, disorders, diagnostic tests and procedures

Muscular System Word Parts

Click on prefixes, combining forms, and suffixes to reveal a list of word parts to memorize for the muscular system.

Prefix

- **a-** (absence of, without)
- **ab-** (away from)
- **ad-** (towards)
- **dys-** (painful, difficult, abnormal, laboured)
- **hyper-** (above, excessive)
- **inter-** (between)
- **intra-** (within, in)
- **poly-** (many, much)
- **sub-** (below, under)
- **supra-** (above)
- **sym-** (together, joined)

- **syn-** (together, joined)

Combining Form

- **kinesi/o** (movement, motion)
- **my/o** (muscle)
- **myos/o** (muscle)
- **radi/o** (nerve root)
- **sarc/o** (flesh, connective tissue)
- **ten/o** (tendon)
- **tendin/o** (tendon)
- **tend/o** (tendon)

Suffix

- **-al** (pertaining to)
- **-algia** (pain)
- **-ar** (pertaining to)
- **-asthenia** (weakness)
- **-centesis** (surgical puncture to aspirate fluid)
- **-desis** (surgical fixation, fusion)
- **-ectomy** (excision, surgical removal, cutting out)
- **-gram** (the record, radiographic image)
- **-graphy** (process of recording, radiographic imaging)
- **-ic** (pertaining to)
- **-itis** (inflammation)
- **-lysis** (loosening, separating, dissolution)
- **-oid** (resembling)
- **-oma** (tumour)
- **-penia** (abnormal reduction)
- **-physis** (growth)
- **-plasty** (surgical repair)
- **-rrhaphy** (suturing, repairing)
- **-sarcoma** (malignant tumour)
- **-schisis** (split, fissure)
- **-scopy** (process of viewing, visual examination)
- **-sis** (abnormal condition)
- **-tomy** (incision, cut into)
- **-trophy** (nourishment, development)

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Introduction to the Muscular System

When most people think of muscles, they think of the muscles that are visible just under the skin, particularly of the limbs. The skeletal muscles are so-named because most of them move the skeleton. But there are two additional types of muscles: the smooth muscle and the cardiac muscle. The body has over 600 muscles, which contribute significantly to the body's weight.

Watch Muscles, Part 2 – Organismal Level: Crash Course Anatomy & Physiology #22 (11 min)
(<https://youtu.be/I80Xx7pA9hQ>)

Muscular System Medical Terms

Muscular System Medical Terms (Text Version)

Practice the following muscular system words by breaking into word parts and pronouncing.

1. **rhabdomyolysis (rhabd/o/my/o/lysis)**
 - dissolution of a striated muscle
2. **bradykinesia (brady/kines/ia)**
 - condition of slow movement
3. **myorrhaphy (my/o/rrhaphy)**
 - suturing of a muscle
4. **dystrophy (dys/trophy)**
 - abnormal development
5. **tendinitis (tendin/itis)**
 - inflammation of the tendon
6. **electromyogram (electr/o/my/o/gram)**
 - record of the electricity of the muscle
7. **hyperkinesia (hyper/kines/ia)**
 - condition of excessive movement

8. **myasthenia (my/asthenia)**
 - weakness of muscles, muscle weakness
9. **hypertrophy (hyper/trophy)**
 - excessive development
10. **dyskinesia (dys/kines/ia)**
 - condition of difficult movement
11. **tenomyoplasty (ten/o/my/o/plasty)**
 - surgical repair of tendon and muscle
12. **myeloma (myel/oma)**
 - tumour in the spinal cord
13. **myalgia (my/algia)**
 - painful muscles
14. **polymyositis (poly/myos/itis)**
 - inflammation of many muscles
15. **tenorrhaphy (ten/o/rrhaphy)**
 - suturing of a tendon
16. **fibromyalgia (fibr/o/my/algia)**
 - pain in the fibers of muscles

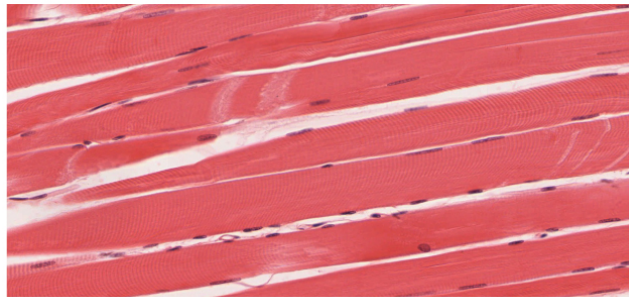
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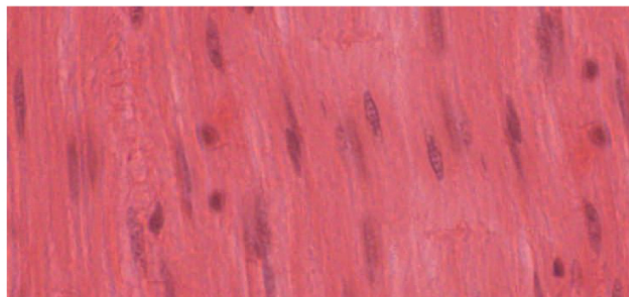
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14.2 - Anatomy (Structures) of the Muscular System

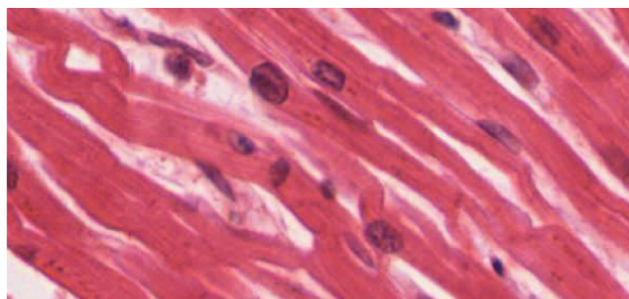
Muscle is one of the four primary tissue types of the body, and it is made up of specialized cells called fibers. The body contains three types of muscle tissue: **skeletal muscle**, **cardiac muscle**, and **smooth muscle** (see Figure 14.1). All three muscle tissues have some properties in common; they all exhibit a quality called **excitability**, as their plasma membranes can change their electrical states (from polarized to depolarized) and send an electrical wave called an action potential along the entire length of the membrane. Fascia is fibrous connective tissue that encloses muscles.



(a)



(b)



(c)

Figure 14.1 The Three Types of Muscle Tissue. The body contains three types of muscle tissue: (a) skeletal muscle, (b) smooth muscle, and (c) cardiac muscle. (Micrographs provided by the Regents of University of Michigan Medical School © 2012). From Betts et al., 2013. Licensed under CC BY 4.0.

Three Types of Muscle Tissues

- **Skeletal:** closely associated with the skeletal system. Also known as striated muscles and are responsible for voluntary muscle movement – such as swallowing, etc.
- **Smooth:** mainly associated with the walls of the internal organs. Also known as visceral muscles and are responsible for involuntary muscle movement – such as breathing, etc.
- **Cardiac:** heart muscle or myocardium. Its appearance is similar to a skeletal muscle and is responsible for the pumping of blood. It gives the heartbeat.

Did You Know?

The gluteus maximus is the largest muscle and the heart is the hardest working muscle.

Skeletal Muscle

Skeletal muscles act not only to produce movement but also to stop movement, such as resisting gravity to maintain posture. Small, constant adjustments of the skeletal muscles are needed to hold a body upright or balanced in any position. Muscles also prevent excess movement of the bones and joints, maintaining skeletal stability and preventing skeletal structure damage or deformation.

Skeletal muscles are located throughout the body at the openings of internal tracts to control the movement of various substances. These muscles allow functions, such as swallowing, urination, and defecation, under voluntary control. Skeletal muscles also protect internal organs (particularly abdominal and pelvic organs) by acting as an external barrier or shield to external trauma and by supporting the weight of the organs.

Skeletal muscles contribute to the maintenance of **homeostasis** in the body by generating heat. This heat is very noticeable during exercise when sustained muscle movement causes body temperature to rise, and in cases of extreme cold, when shivering produces random skeletal muscle contractions to generate heat.

Smooth Muscle

Smooth muscle, so named because the cells do not have striations, is present in the walls of hollow organs like the urinary bladder, uterus, stomach, intestines, in the walls of passageways, such as the arteries and veins of the circulatory system, and the tracts of the respiratory, urinary, and reproductive systems. Smooth muscle is also

present in the eyes, where it functions to change the size of the iris and alter the shape of the lens, and in the skin, where it causes hair to stand erect in response to cold temperature or fear.

Cardiac Muscle

Cardiac muscle tissue is only found in the heart. Highly coordinated contractions of cardiac muscle pump blood into the vessels of the circulatory system. Similar to skeletal muscle, cardiac muscle is striated and organized into **sarcomeres**, possessing the same banding organization as skeletal muscle (see Figure 14.1). Cardiac muscle fibers cells also are extensively branched and are connected to one another at their ends by intercalated discs. An **intercalated disc** allows the cardiac muscle cells to contract in a wave-like pattern so that the heart can work as a pump.

Concept Check

- Compare and contrast the 3 types of muscles tissues.
- Where in the body do you find each of the muscle types?

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14.3 - Physiology (Function) of the Muscular System

The main function of the muscular system is to assist with **movement**. Muscles work as **antagonistic** pairs. As one muscle contracts, the other muscle relaxes. This contraction pulls on the bones and assists with movement. Contraction is the shortening of the muscle fibers while relaxation lengthens the fibers. This sequence of relaxation and contraction is influenced by the nervous system.

Muscles also work to keep the **posture** of the body. This is done through muscle contraction, where the trunk is kept straight either when sitting or standing.

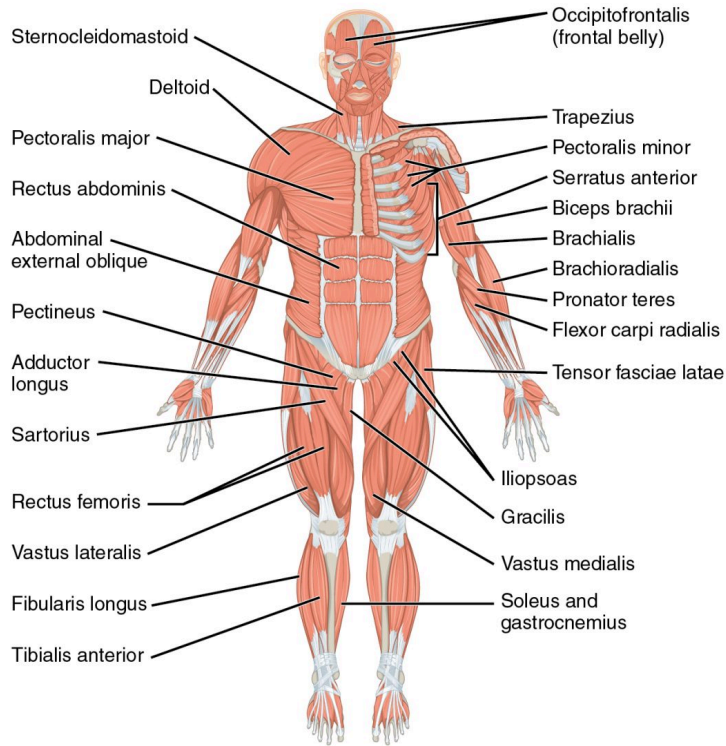
Naming of Muscles

Did You Know?

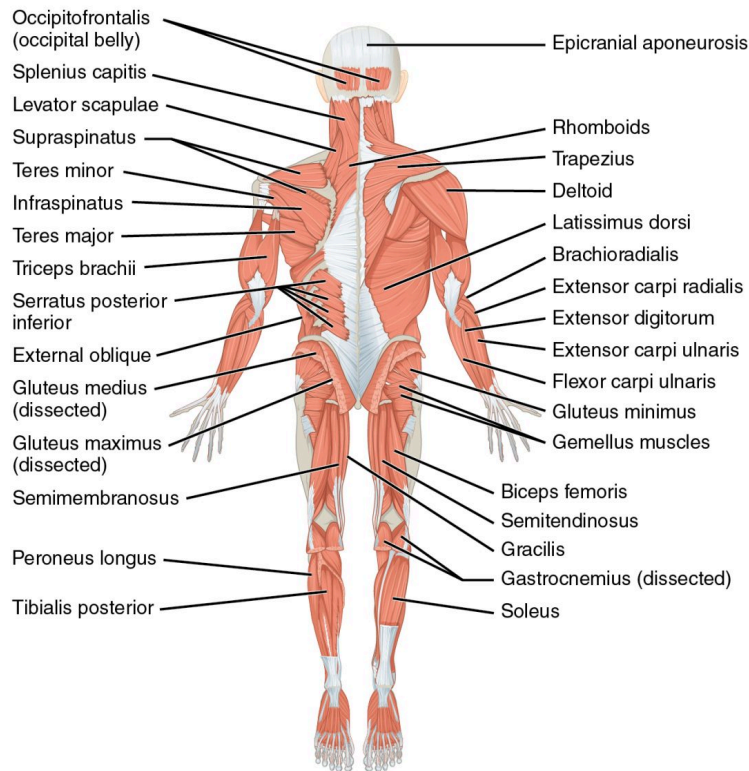
The tongue is made up of many muscles and muscles work in pairs.

There are many **nomenclatures** for naming muscles. Some of these include:

- **divisions:** biceps, triceps, quadriceps
- **size:** maximus (largest), minimus (smallest)
- **shape:** deltoid (triangular), trapezius (trapezoid)
- **action:** flexor (to flex), adductor (towards the midline of the body)



Major muscles of the body.
Right side: superficial; left side:
deep (anterior view)



Major muscles of the body.
Right side: superficial; left side:
deep (posterior view)

Figure 14.2. Overview of the Muscular System. On the anterior and posterior views of the muscular system above, superficial muscles (those at the surface) are shown on the right side of the body while deep muscles (those underneath the superficial muscles) are shown on the left half of the body. For the legs, superficial muscles are shown in the anterior view while the posterior view shows both superficial and deep muscles. From Betts et al., 2013. Licensed under CC BY 4.0. [Fig. 14.2 Image description.]

Table 14.1a-b. Understanding a Muscle Name from the Latin. Adapted from Betts et al., 2013. Licensed under CC BY 4.0.

Table 14.1a. Understanding a Muscle Name from the Latin. Example: abductor digiti minimi. Translation: A muscle that moves the little finger or toe away. Adapted from Betts et al., 2013. Licensed under CC BY 4.0.

Word	Latin Root 1	Latin Root 2	Meaning
abductor	ab = away from	duct = to move	a muscle that moves away from
digiti	digitus = digit	n/a	refers to a finger or toe
minimi	minimus = mini, tiny	n/a	little

Table 14.1b. Understanding a Muscle Name from the Latin. Example: adductor digiti minimi. Translation: A muscle that moves the little finger or toe toward. Adapted from Betts et al., 2013. Licensed under CC BY 4.0.

Word	Latin Root 1	Latin Root 2	Meaning
adductor	ad = to, toward	duct = to move	a muscle that moves towards
digiti	digitus = digit	n/a	refers to a finger or toe
minimi	minimus = mini, tiny	n/a	little

Muscular System Medical Abbreviations

Muscular System Abbreviations

- **DC** (Doctor of Chiropractic)
- **DO** (Doctor of Osteopathy)
- **EMG** (Electromyogram)
- **MD** (Muscular Dystrophy)
- **MG** (myasthenia gravis)
- **Ortho** (orthopedics)

Activity source: Muscular System Abbreviations by Kimberlee Carter and Heather Scudder, from *Building a Medical Terminology Foundation* by Kimberlee Carter and Marie Rutherford, licensed under CC BY- 4.0. / Converted to text.

Image Descriptions

Figure 14.2 image description: The top panel shows the anterior view of the human body with the major muscles labeled. Labels read (from top, head): occipitofrontalis (frontal belly), sternocleidomastoid, trapezius, deltoid, pectoralis minor, serratus anterior, pectoralis major, arm muscles: biceps brachii, brachialis, brachioradialis, pronator teres, flexor carpi radialis, abdominal: rectus abdominis, abdominal external oblique, lower body: tensor fasciae latae, iliopsoas, pectineus, adductor longus, sartorius, gracilis, rectus femoris, vastus lateralis, vastus medialis, fibularis longus, tibialis anterior. The bottom panel shows the posterior view of the human body with the major muscles labeled. Labels read (from top, head, left side): epicranial aponeurosis, occipitofrontalis, splenius capitis, levator scapulae, rhombus, trapezius, supraspinatus, teras minor, infraspinatus, teres major, triceps brachii, seratus posterior inferior, external oblique, lower body: gluteus medius, gluteus maximus, semimebranosus, peroneus longus, tibialis posterior, (right side, from top) trapezius, deltpid, latissimus dorsi, arm: brachioradialis, extensor carpi radialis, extensor digitorum, extensor carpi ulnaris, flexor carpi ulnaris, lower body: gluteus minimus, gemellus muscles, biceps femoris, semitendinosus, gracilis, gastrocnemius, soleus. [Return to Figure 14.2].

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14.4 - Muscular Diseases, Disorders and Diagnostic Testing

Common Diseases and Disorders

Duchenne Muscular Dystrophy

Duchenne Muscular Dystrophy (DMD) is caused by the inability of the body to make dystrophin (a muscle protein). This causes the muscles to become weak as the person ages. This disease primarily affects boys, and signs and symptoms typically present before the age of five. Signs and symptoms may include frequent falls and trouble keeping up with peers. Since all muscles are affected, the person will eventually require a wheelchair and assistance with breathing (Muscular Dystrophy Canada, 2020). To learn more, please visit Muscular Dystrophy Canada's neuromuscular disorders web page [New Tab] (<https://muscle.ca/discover-md/types-of-neuromuscular-disorders/>).

Cerebral Palsy

Cerebral Palsy (CP) is caused by an interruption to the normal development of a person's brain, leading to weakness in muscles. Depending on the area of the brain that is affected, signs and symptoms will vary in the type and severity between individuals. Balance and coordination are often challenging due to the inability to control muscles (Centers for Disease Control and Prevention, 2024; Ontario Federation for Cerebral Palsy, 2018). To learn more about Cerebral Palsy, please visit the Centers for Disease Control and Prevention [New Tab] (<https://www.cdc.gov/ncbddd/cp/facts.html>).

Carpal Tunnel Syndrome

Carpal tunnel syndrome may present with pain, numbness or weakness in the hand(s) caused by pressure on the median nerve. Some causes for this pressure are work-related, such as keyboarding with improper body mechanics, illnesses such as arthritis, and even pregnancy (Cleveland Clinic, 2024). To learn more, visit Cleveland Clinic's Carpal Tunnel web page [New Tab] (<https://my.clevelandclinic.org/health/diseases/4005-carpal-tunnel-syndrome>).

Paralysis

Paralysis is the loss of strength and control of the muscles in parts of the body. Paralysis can be localized, where

it affects specific areas such as the face, feet, vocal cords, etc., or it can be generalized, where it affects a larger area of the body. There are various types of generalized paralysis, including:

- **Paresis:** a partial paralysis wherein there is still some control of the muscles
- **Paraplegia:** paralysis that affects both legs and lower part of the body
- **Quadriplegia:** affects both arms, both legs and sometimes from the neck down
- **Hemiplegia:** affects one side of the body. For example, the arm and leg on the same side of the body (Cleveland Clinic, 2021)

To learn more about paralysis, please visit the Cleveland Clinic's Paralysis information web page [New Tab] (<https://my.clevelandclinic.org/health/diseases/15345-paralysis>).

Sprain and Strain

A **sprain** is an injury to a joint whereby a ligament is stretched or torn.

A **strain** is an injury to a muscle whereby a tendon is stretched or torn.

Diagnostic Procedures

Electromyography (EMG) is a procedure that assesses the function of nerve cells that control muscles. Electrodes, either attached to the skin or inserted into the muscle, allow for the recording of electrical impulses. EMG can indicate functional problems with the peripheral nerves, muscles, or with the signals between the nerves and the muscles. This is just one test in a series of tests that assist in the diagnosis of neuromuscular disorders (Mayo Clinic Staff, 2019). To learn more, please visit the Mayo Clinic's Electromyography web page [New Tab]. (<https://www.mayoclinic.org/tests-procedures/emg/about/pac-20393913>)

Magnetic Resonance Imaging (MRI) is a test that uses radio frequency waves and a magnetic field to produce clear images that aid in the diagnosis of a wide range of conditions (London Health Sciences Centre, 2020). Leung (2017) notes that there has been increased clinical use of MRI for the treatment and monitoring of muscular disorders due to the high-quality MRI images that distinguish skeletal muscles from fat (para. 4).

Range of Motion Testing is a diagnostic procedure used to determine the amount of movement around a specific joint.

Medical Terminology in Context

Musculoskeletal System – Referral Letter

Musculoskeletal System – Referral Letter (Text version)

Use the words below to fill in the referral letter:

- CTS
- tingling
- numbness
- osteoarthritis
- clumsiness
- metacarpal
- atrophy
- arthrodesis
- flexion
- tenorrhaphy
- median
- ligament

PATIENT NAME: Mrs. Anna JONES

AGE: 65

SEX: Female

DOB: June 29

REASON FOR REFERRAL: Evaluation and consideration for surgery for treating carpal tunnel syndrome.

Dear Dr. Porter

I am referring Mrs. Jones for evaluation and consideration for surgery for treating _____[Blank 1]. Mrs. Jones is 65 years old. She has moved to this area 2 years ago and I have been her primary care physician since then. Recently she has been complaining of _____[Blank 2], tingling, burning, and pain in her right hand, primarily in the thumb, index, and middle fingers. Occasionally the pain and _____[Blank 3] travel up the forearm toward her shoulder. The patient reports that the pain and unusual sensations have started gradually and worsened over the past couple of years.

The patient has worked as a data entry clerk at a pharmaceutical company for 35 years. Her work involved sitting at her desk and typing on a computer for an average of 7 hours on each workday. She is retired now. The patient reports that during the past few months she has also felt weakness and _____[Blank 4] in her hand, and this has made her everyday life difficult. She can tell that her grip is not as strong as before since she frequently drops things. Now she is finding the simple tasks such as buttoning her clothes, cutting vegetables, and brushing her teeth challenging. The x-ray of the right hand and wrist shows clear signs of _____[Blank 5] and osteoporosis of carpal and _____[Blank 6] bones. On visual examination there is no muscle . The wrist has limited _____[Blank 7] and extension range of motion.

It is important to note that the patient had been in a car accident in her teenage years and had suffered from a compact fracture of her left wrist bones. Multiple surgeries, including arthroplasty and _____[Blank 8], were done to restore the functionality of the left wrist and hand. Eventually, her orthopedic surgeon performed a subtotal _____[Blank 9] of the wrist to provide a stable and pain-free joint with a limited useful range of motion.

Based on the aforementioned observations and findings I have determined that Mrs. Jones is a fit

candidate for CTS surgery. A proper cut in the transverse carpal _____[Blank 10] would release the pressure off the _____[Blank 11] nerve and relieve the symptoms.

Thank you for seeing Mrs. Jones. Please do not hesitate to contact me directly with any questions or comments you may have concerning her care. Also, please keep me updated on her progress and kindly refer her back to my care once her condition resolves.

Trevor Sharpe, MD, Family Medicine

Note: Report samples (H5P and Pressbooks) are to encourage learners to identify correct medical terminology and do not represent the Association for Health Documentation Integrity (AHDI) formatting standards.

Check your answers:¹

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Medical Specialties Related to Muscular System

Orthopedic Surgeon

Orthopedic Surgeons are medical doctors who complete an additional 5-years of specialized training in the prevention, diagnosis, treatment and surgery of disorders and diseases related to the musculoskeletal systems (Canadian Medical Association, 2019). For more details, please visit the Canadian Medical Association's page on Orthopedic Surgery [PDF] (<https://www.cma.ca/sites/default/files/2019-01/orthopedic-surgery-e.pdf>).

Neurologist

Neurologists are medical doctors who complete an additional 5 years of specialized training in the prevention, diagnosis, and treatment of disorders and conditions related to the brain, spinal cord, nerves and muscles (Canadian Medical Association, 2019). For more details, visit the Canadian Medical Association's page on Neurology profile [PDF] (<https://www.cma.ca/sites/default/files/2019-01/neurology-e.pdf>).

Kinesiologist

Kinesiologists are regulated health-care professionals with a four-year degree in kinesiology or related discipline. In Ontario, a kinesiologist must be registered and in good standing with the College of Kinesiologists of Ontario. Kinesiologists work in a variety of settings that assist people with pain management, injury prevention, and health promotion through biomechanics (College of Kinesiologists of Ontario, n.d.). To learn more, visit the College of Kinesiologists of Ontario's website [New Tab] (<https://www.coko.ca/patients-and-clients/about-kinesiology/>).

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Notes

1. 1. CTS, 2.numbness, 3.tingling, 4.clumsiness, 5.osteoarthritis, 6.metacarpal, 7.atrophy, 8. tenorrhaphy, 9.arthrodesis, 10. ligament, 11.median

Vocabulary & Check Your Knowledge

Muscular System Vocabulary

Antagonistic

In opposition to each other.

Cardiac muscle

The heart muscle also known as the myocardium. Its appearance is similar to skeletal muscle. It pumps blood and gives the heartbeat.

Electromyography (EMG)

Measures muscle response or electrical activity in response to a nerve's stimulation of the muscle.

Fibromyalgia

Pain in the fibrous tissues of muscles.

Hemostasis

Biological process that results in stable equilibrium.

Hemiplegia

Paralysis that affects one side of the body.

Magnetic Resonance Imaging (MRI)

Radiofrequency waves and a strong magnetic field provide clear and detailed pictures of internal organs and tissues.

Myasthenia Gravis

Grave or serious muscle weakness.

Paraplegia

Paralysis that affects both legs and lower part of the body.

Paresis

Partial paralysis wherein there is still some control of the muscles.

Quadriplegia

Affects both arms, both legs and sometimes from the neck down.

Skeletal muscle

Also known as striated muscles. Skeletal muscles are responsible for voluntary muscle movement.

Smooth muscle

Also known as visceral muscles. Smooth muscle is mainly associated with the walls of internal organs. Smooth muscles are responsible for involuntary muscle movement.

Sprain

Injury to a joint whereby a ligament is stretched or torn.

Strain

Injury to a muscle whereby a tendon is stretched or torn.

Muscular System Glossary Reinforcement Activity

Muscular System Glossary Reinforcement Activity (Text version)

1. Muscle that is associated with the walls of internal organs and is responsible for involuntary muscle movement is called _____[Blank 1].
 - a. Skeletal muscle
 - b. Smooth muscle
 - c. Cardiac muscle
2. Paralysis that effects one side of the body is called_____ [Blank 2].
 - a. paraplegia
 - b. paresis
 - c. hemiplegia
3. An injury to a joint whereby a ligament is stretched or torn is called _____[Blank 3].
 - a. a sprain
 - b. a strain
 - c. fibromyalgia
4. Myasthenia Gravis is _____[Blank 4].
 - a. pain in the fibrous tissues of muscles.
 - b. grave or serious muscle weakness.
 - c. partial paralysis wherein there is still some control of the muscles.
5. Skeletal muscle is responsible for _____[Blank 5].

- a. voluntary muscle movement.
- b. pumping blood.
- c. involuntary muscle movement.

Check your answers:¹

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Notes

1. 1. Smooth muscle, 2. hemiplegia, 3. a sprain, 4. grave or serious muscle weakness, 5.voluntary muscle movement

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