MUSCULOSKELETAL

Khaleel Alyahya, PhD, MEd
RE COURSES

Mastering Medical Technology
By Sue Walker, Maryann Wood and Jenny Nicol

Essential of Human Anatomy & Physiology
By Elaine Marieb and Suzanne Keller

Mosby’s Dictionary
By Mosby

KENHUB
www.kenhub.com

Atlas of Human Anatomy
By Frank Netter
فَكَسَوْنََ الْعِظَامَ لَحْماً
Musculoskeletal is a general term which is defined as relating to muscles and bones of the skeleton.

The musculoskeletal system comprises bones, joints, cartilage, bursae, tendons, muscles and ligaments.

It is the system that moves the body and maintains its form.

Study of this system consists of osteology (the study of bones), arthrology (the study of joints), and myology (the study of muscles).

The musculoskeletal system does not work in isolation.

It is closely linked with many other systems in the body, including the nervous system, genitourinary system, circulatory system, immune system, respiratory system, digestive system and endocrine system.
BONES
The adult human body consists of **206 bones**.

Prior to birth, the skeleton is made up of flexible cartilage.

As the body grows, ossification takes place as the cartilage is replaced by hard deposits of calcium, phosphorus and collagen, which make up the bones.

In newborn babies the body has **270 bones** but many of these fuse as the child grows.

The smallest bones are the **ossicles** in the middle ear and the largest bones are the right and left **femurs**, or thigh bones.

Around 30–40% of the body’s total weight is made up of the bones.

There are certain differences in the bones of males and females, primarily in the pelvic region because of the requirement of the female pelvis to accommodate pregnancy and childbirth.
The two main divisions of the bones of the body are called the axial skeleton and the appendicular skeleton.

The axial skeleton is made up of the skull, rib cage and vertebral column.

The remainder of the skeleton, including the extremities, is known as the appendicular skeleton.

It is called appendicular because these bones are appended or attached to the axial skeleton.

Bones are classified into five types:

- **Long bones** (such as femur, tibia, humerus, radius).
- **Short bones** (such as the bones in the ankles and wrists).
- **Flat bones** (sternum, cranium, scapula, ribs).
- **Irregular bones** (vertebrae, hips, bones of the face).
- **Sesamoid bones** (round bone masses embedded in tendons, such as the patella).
Functions

- To **provide a framework** to shape and support the body and a place for tendons and muscles to attach
- To **enable movement**, by acting as levers in collaboration with muscles and joints
- To **provide protection** for the body’s most vital and delicate organs, the brain, heart and lungs amongst others
- To **create blood cells** by a process called haematopoiesis, this takes place in the bone marrow
- To **store minerals** such as calcium and iron
- To **help regulate certain hormones** including those that assist with maintenance of blood sugar levels and deposition of fats.
Combining Form

Check page 46-47 from the book "Mastering Medical Terminology" for the complete list of combining form.

<table>
<thead>
<tr>
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<th>Medical term</th>
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### Suffix

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<td>osteoporosis</td>
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<td>scoliosis</td>
<td>sko-lee-OH-sis</td>
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### Abbreviation

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
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<tbody>
<tr>
<td>AKA</td>
<td>above knee amputation</td>
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<tr>
<td>BKA</td>
<td>below knee amputation</td>
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<td>C1–C7</td>
<td>cervical vertebrae 1–7</td>
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<td>Ca</td>
<td>calcium</td>
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<td>fx, #</td>
<td>fracture</td>
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<tr>
<td>L1–L5</td>
<td>lumbar vertebrae 1–5</td>
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<td>NOF</td>
<td>neck of femur</td>
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<tr>
<td>OA</td>
<td>osteoarthritis</td>
</tr>
<tr>
<td>ORIF</td>
<td>open reduction internal fixation (of fracture)</td>
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<tr>
<td>POP</td>
<td>plaster of Paris</td>
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<tr>
<td>RIF/LIF</td>
<td>right iliac fossa/left iliac fossa</td>
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<tr>
<td>S1–S5</td>
<td>sacral vertebrae 1–5</td>
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<tr>
<td>T1–T12</td>
<td>thoracic vertebrae 1–12</td>
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</table>
There are two types of osseous tissue making up bones:
- **Compact** or hard bony tissue (also known as cortical tissue).
- **Cancellous** or spongy tissue.

The difference lies in the denseness of the cells.

**Hard bone** is made up of closely packed cells which have thin canals running through them for blood vessels to pass through.

This **compact tissue** is usually located on the outside of bones and gives bones their characteristic hard, smooth, white appearance.

**Cancellous (Spongy) bone** has spaces in between the cells, giving it a lattice-like appearance.

This type of osseous tissue is generally found on the inside of bones, is highly vascular and generally houses the bone marrow where haematopoiesis takes place.
In a long bone, the **diaphysis** or shaft, makes up most of the bone's length and is composed of compact bone.

The diaphysis is covered and protected by a fibrous connective tissue membrane, the **periosteum**.

Hundreds of connective tissue fibers, called perforating fibers, or Sharpey's fibers, secure the periosteum to the underlying bone.

The **epiphyses** are the ends of long bones.

Each epiphysis consists of a thin layer of compact bone enclosing an area filled with **spongy bone**.

Instead of a periosteum, articular cartilage covers its external surface.

In adult bones, there is a thin line of bony tissue spanning the epiphysis that looks a bit different from the rest of the bone in that area. This is the **epiphyseal line**.
The inner bony surface of the shaft is covered by a delicate connective tissue called endosteum.

In infants, the cavity of the shaft, called the medullary cavity, is a storage area for red marrow, which produces blood cells.

Children’s bones contain red marrow until the age of 6 or 7, when it is gradually replaced by yellow marrow, which stores adipose (fat) tissue.

In adult bones, red marrow is confined to cavities in the spongy bone of the axial skeleton, the hip bones, and the epiphyses of long bones such as the humerus and femur.

There are two categories of bone markings:

- Projections, or processes, which grow out from the bone surface,
- Depressions, or cavities, which are indentations in the bone.
Long Bones

- Long bones include femur (the longest bone in the body) and small bones in the fingers.
- Function to support the weight of the body and facilitate movement.
- Located in the appendicular skeleton and include bones in upper and lower limbs.
- Formed of:
  - A shaft (diaphysis): composed of compact bone.
  - Two ends (epiphysis): composed of spongy bone.
  - The region of contact between epiphysis & diaphysis is called: metaphysis
- Located in the wrist and ankle joints,
- Short bones provide stability and some movement.
- Examples of short bones:
  - The carpals in the wrist
  - The tarsals in the ankles
There are flat bones in the skull, the thoracic cage and the pelvis.

The function of flat bones is to protect internal organs such as the brain, heart, and pelvic organs.

Flat bones can also provide large areas of attachment for muscles.

Examples of flat bones:
- occipital, parietal and frontal in skull.
- sternum and ribs in thoracic cage.
- ilium and pubis in pelvis.
Irregular bones vary in shape and structure and therefore do not fit into any other category (flat, short, long, or sesamoid).

- They often have a fairly complex shape, which helps protect internal organs.
- For example, the vertebrae protect the spinal cord.
- Also, the irregular bones of the pelvis (pubis, ilium, and ischium) protect organs in the pelvic cavity.
- Sesamoid bones are bones embedded in tendons.
- These small, round bones are commonly found in the tendons of the hands, knees, and feet.
- Sesamoid bone's function is to protect tendons from stress.
- The patella is an example of a sesamoid bone.
Pathology & Diseases
Curvature of Spine

- **Kyphosis** is an abnormal convex or posterior curvature of the thoracic spine. It is also called hunchback or humpback.
- **Lordosis** is an abnormal concave or anterior curvature of the lumbar spine. It is also called a sway back.
- **Scoliosis** is a lateral S-shaped curvature of the spine.
A fracture is a break or crack in a bone.

Fractures are caused by trauma such as a faller motor vehicle accident, through overuse or repetitive movements as may occur in athletes, or as a result of a disease process such as osteoporosis that weakens the bones.

Fractures are classified by type and whether they are open or closed.

Open fracture: a fracture in which there is an open wound communicating with the fracture exposing the underlying bone. There is an increased risk of infection with an open fracture.

Closed fracture: the bone is broken but there is no open wound.
Intervertebral discs are pillows of fibrocartilagenous tissue located between the vertebrae of the spine.

Sometimes as a result of an acute injury to the spine or because of degenerative wear and tear to a disc, it splits or ruptures.

When this happens, the inner gel-like substance (nucleus pulposus) leaks out into the spinal canal.

This is called a herniation of the nucleus pulposus — or a herniated disc.

A herniated disc is often referred to as a slipped disc, but this terminology is erroneous as a disc cannot actually slip.

The most common site for a herniated disc is in the lumbar spine especially at L4–L5.

Symptoms will vary depending on the site and degree of the herniation but can include paraesthesia sciatica and back pain.

Some patients will not experience any pain at all.

Many cases will resolve spontaneously with bed rest, analgesics and physiotherapy, but if the condition persists, more invasive treatment such as discectomy or laminectomy may be required.
Osteomalacia is a softening of the bones due to a lack of vitamin D or a problem with the body’s ability to metabolize and absorb this vitamin.

Adequate amounts of vitamin D are essential for the body to be able to absorb calcium and phosphorous into the bloodstream.

Vitamin D deficiency may be caused by a lack in the diet, limited exposure to sunlight which produces vitamin D in the body or malabsorption by the intestines.

Treatment involves vitamin D, calcium and phosphorous supplements.

In children, osteomalacia is called rickets.
▪ Osteoporosis occurs when there is a decrease in bone density due to bones losing minerals, such as calcium, more quickly than the body can replace them.

▪ Bones become porous and brittle resulting in an increased likelihood of fractures.

▪ While any bone can be affected by osteoporosis, the most common sites for osteoporotic fractures are the hip, spine, ribs, pelvis, wrist and upper arm.

▪ While it is most frequently seen in postmenopausal women due to decreased levels of oestrogen, osteoporosis can occur in younger women and in men.
JOINTS

Synarthrosis

Diarthrosis

Amphiarthrosis
Introduction

- Joints are the location where two or more bones come together to create body movement or articulation.
- There are three types of joints classified according to whether they move a lot, a little, or not at all:
  - Fibrous
  - Cartilaginous
  - Synovial
- Also, joints can be classified based on the number of bones involved, and into complex and combination joints:
  - Simple joint:
    - two articulation surfaces (shoulder and hip joints)
  - Compound joint:
    - three or more articulation surfaces (radiocarpal joint)
  - Complex joint:
    - two or more articulation surfaces and an articular disc or meniscus (knee joint)
Introduction

- Most joints are mobile, allowing the bones to move.
- Joints consist of the following:
  - **Cartilage**
    - This is a type of tissue that covers the surface of a bone at a joint.
    - Cartilage helps reduce the friction of movement within a joint.
  - **Synovial membrane**
    - A tissue called the synovial membrane lines the joint and seals it into a joint capsule.
    - The synovial membrane secretes a clear, sticky fluid (synovial fluid) around the joint to lubricate it.
  - **Synovial fluid**
    - A clear, sticky fluid secreted by the synovial membrane.
  - **Ligaments**
    - Strong ligaments (tough, elastic bands of connective tissue) surround the joint to give support and limit the joint's movement.
    - Ligaments connect bones together.
  - **Tendons**
    - Tendons (another type of tough connective tissue) on each side of a joint attach to muscles that control movement of the joint.
    - Tendons connect muscles to bones.
  - **Bursae**
    - Fluid-filled sacs, called bursas, between bones, ligaments, or other nearby structures.
    - They help cushion the friction in a joint.
  - **Meniscus**
    - This is a curved part of cartilage in the knees and other joints.
### Combining Form

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<th>Meaning</th>
<th>Medical term</th>
<th>Meaning of medical term</th>
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<td>crooked, bent, stiff</td>
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### Abbreviation

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<tr>
<th>Abbreviation</th>
<th>Definition</th>
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<td>DJD</td>
<td>degenerative joint disease</td>
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<td>DMARD</td>
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<tr>
<td>RA</td>
<td>rheumatoid arthritis</td>
</tr>
<tr>
<td>ROM</td>
<td>range of movement</td>
</tr>
<tr>
<td>THR</td>
<td>total hip replacement</td>
</tr>
<tr>
<td>TKR</td>
<td>total knee replacement</td>
</tr>
<tr>
<td>TMJ</td>
<td>temporomandibular joint</td>
</tr>
</tbody>
</table>
Fibrous joints are fixed and unable to move because thick membranous collagen fibers hold the bones together.

This type of joint is found in the skull where the coronal suture joins the frontal and parietal bones; the sagittal suture joins the two parietal bones from the front to the back and the lambdoid suture joins the parietal bones with the occipital bone.

Examples:
- **Skull sutures**: No movement
- **Inferior tibiofibular joints**: very Little movement, permanent joints.
- **Gomphoses**: Between teeth and their socket.

Fibrous Joints
Cartilaginous joints have cartilage between them. Although they allow movement, this is far more restricted than the movement of synovial joints. The joints of the vertebral column and the pelvis are examples of this type of joint.

**Primary Cartilaginous**
- The bones are united by a plate or a bar of hyaline cartilage.
- No movement, temporary joints.
- **Example:**
  - Between the Epiphysis and Diaphysis of a growing bone.
  - Between the First Rib and the Sternum (1st sternocostal joint).

**Secondary Cartilaginous**
- The bones are united by a plate of fibrocartilage.
- Little movement, permanent joints.
- They are called Midline joints.
- **Example:**
  - Joints between the Vertebral Bodies (intervertebral discs).
  - Symphysis Pubis
Synovial joints permit the greatest range of movement.

In between the bones are spaces covered with synovial membrane, which fill with synovial fluid.

This fluid lubricates and protects the bones as they move.

The articular surfaces are covered by a thin layer of hyaline cartilage (articular cartilage).

A joint cavity enclosed within the capsule.

A thin vascular synovial membrane lining the inner surface of the capsule.

A lubricating synovial fluid produced by synovial membrane in the joint cavity.

The fluid minimizes the friction between the articular surfaces.
Classifications of Synovial Joints

- Synovial joints permit the greatest range of movement.
- According to the range of movement synovial joints are classified into:
  - **Plane Synovial Joints**
    - The articulating surfaces are flat.
    - The bones slide on one another, producing a gliding movement.
    - Examples:
      - Intercarpal Joints
      - Sternoclavicular joint
      - Acromioclavicular joint
  - **Axial Synovial Joints**
    - Movements occur along an axes:
      - Transverse axis: flexion & extension.
      - Longitudinal axis: rotation.
      - Antero-posterior axis: abduction & adduction.
    - Axial joints are divided into:
      - Uniaxial.
      - Biaxial.
      - Multi-axial or (polyaxial).
- **Hinge joints**
  - Axis: transverse.
  - Movements: flexion & extension.
  - Example: elbow joint and ankle joint.

- **Pivot joints**
  - Axis: longitudinal.
  - Movements: rotation.
  - Example: radio-ulnar and atlantoaxial joint.
    - A joint in the upper part of the neck between the first and second cervical vertebrae; the atlas and axis
Biaxial Synovial Joints

- **Ellipsoid joints:**
  - An elliptical convex fits into an elliptical concave articular surfaces.
  - Axes: Transverse & anteroposterior.
  - Movements: flexion & extension + abduction & adduction. BUT rotation is impossible.
  - Example: Wrist joint.

- **Saddle joints**
  - The articular surfaces are reciprocally concavoconvex.
  - They resemble a saddle on a horse’s back.
  - Movement:
    - As ellipsoid joints (Flexion & extension + abduction & adduction) + a small range of rotation.
    - Example: Carpometacarpal joint of the thumb.
Polyaxial Synovial Joints

- **Ball-and-Socket joints:**
  - A ball–shaped head of a bone fits into a socket-like concavity of another.
  - Examples:
    - Shoulder joint.
    - Hip joint.
Factors Effecting Stability of Synovial Joints

- **The shape of articular surfaces:**
  - The ball and socket shape of the Hip joint is a good example of the importance of the shape of the bone, to maintain joint stability.
  - The shape of the bones forming the Knee joint has nothing to do for stability.

- **Strength of the ligaments:**
  - They prevent excessive movement in a joint.

- **Tone of the surrounding muscles:**
  - In most joints, it is the major factor controlling stability.
  - The short muscles around the shoulder joint (rotator cuff) keeps the head of the humerus in the shallow glenoid cavity.
Pathology & Diseases
Arthritis

- Arthritis is inflammation of a joint resulting in pain, swelling and alteration to structure and function.
- There are several types of arthritis with different aetiologies.
Osteoarthritis

- Osteoarthritis is the most common form of joint inflammation (arthritis).
- It stems from heavy use of articular joints over the course of many years, which can result in the wearing away of articular cartilage.
- The changes which occur are irreversible and degenerative. This results in the decreased effectiveness of articular cartilage as a shock absorber and lubricated surface, as well as the roughened edges causing further damage.
- As a result of this degeneration, repeated friction can cause symptoms of joint pain, stiffness and discomfort.
- This condition usually affects joints that support full body weight, such as the hips and the knees.
A dislocation (also called a luxation) is the displacement of two bones from their position where they articulate in a joint.

It usually occurs as the result of trauma.

Ligaments in the joint are usually injured as well.

A subluxation is a partial dislocation.

An x-ray is required to identify if a fracture has also occurred.

Any dislocation needs to be reduced urgently to prevent complications such as ischaemia.
<table>
<thead>
<tr>
<th>Term</th>
<th>Pronunciation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>arthritis</td>
<td>arth-RY-tis</td>
<td>Arthritis is inflammation of a joint resulting in pain, swelling and alteration to structure and function. There are several types of arthritis with different aetiologies.</td>
</tr>
<tr>
<td>osteoarthritis (OA)</td>
<td>os-tee-o-arth-RY-tis</td>
<td>Osteoarthritis is a progressive, degenerative joint disease characterised by loss of articular cartilage, the presence of osteophytes and hypertrophy of bone. This leaves the ends of the bones unprotected, and the joint loses its ability to move smoothly and becomes painful and stiff. Osteoarthritis occurs mainly in the hips and knees. It is diagnosed by clinical history and x-ray. Treatment consists of analgesic medication such as aspirin, and physiotherapy. As the disease progresses, joint replacement surgery may be necessary.</td>
</tr>
<tr>
<td>rheumatoid arthritis (RA)</td>
<td>ROO-ma-toyd arth-RY-tis</td>
<td>Rheumatoid arthritis is a chronic autoimmune disease in which the body’s immune system attacks the synovium, the thin membrane that lines each joint. As a result, fluid builds up in the joints causing pain and inflammation. Joint deformity and stiffness often result. The hands, feet and knees are most commonly affected. There is no cure but RA can be managed with NSAID (non-steroidal anti-inflammatory drug) medication to reduce pain, DMARDs (disease-modifying antirheumatic drugs) to stop disease progression and physiotherapy. Complementary therapies such as acupuncture and massage may help some patients.</td>
</tr>
<tr>
<td>gouty arthritis (gout)</td>
<td>GOW-tee arth-RY-tis</td>
<td>Gouty arthritis is caused by hyperuricaemia (a build-up of uric acid in the blood) resulting in the formation of tiny crystals of urate in body tissues. When the crystals form in joints, acute arthritis results. The feet, ankles, wrists and fingers can be affected but the big toe is the most common site. Repeated bouts of gouty arthritis can damage the joint and lead to chronic arthritis. A diet high in fats and alcohol and a family history are possible causes of gout. Men are more likely to develop gouty arthritis than are women. While gout is a progressive disease, there are effective treatments to lower uric acid levels and prevent inflammation. Dietary restrictions to reduce intake of fats and alcohol are required.</td>
</tr>
<tr>
<td>Term</td>
<td>Pronunciation</td>
<td>Definition</td>
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</tr>
<tr>
<td>bunion</td>
<td>BUN-yun</td>
<td>A bunion (hallux valgus) is an abnormal swelling of the medial aspect of the joint between the big toe and the first metatarsal bones. It is a common disorder that is caused by degenerative joint disease, pressure from poorly fitting shoes or can be hereditary. Treatment involves wearing wide-toed shoes with cushioned lining. If the bunion is severe, a bunectomy may be performed.</td>
</tr>
<tr>
<td>bursitis</td>
<td>bur-SY-tis</td>
<td>Bursitis is inflammation of a bursa (a fibrous fluid-filled sac between a tendon and bone). Normally, the bursa provides a slippery surface that assists movement and reduces friction. When a bursa becomes inflamed it results in joint pain, stiffness and swelling around the affected joint. Bursitis is caused by chronic overuse, trauma and infection. The most commonly affected joints are the shoulder, elbow, knee and hip. Treatment consists of administering NSAIDs such as ibuprofen, physiotherapy and rest as required. In some cases an injection of a corticosteroid into the joint is required.</td>
</tr>
<tr>
<td>dislocation</td>
<td>dis-loh-KAY-shun</td>
<td>A dislocation (also called a luxation) is the displacement of two bones from their normal position where they articulate in a joint. It usually occurs as the result of trauma. Ligaments in the joint are usually injured as well. A subluxation is a partial dislocation. An x-ray is required to identify if a fracture has also occurred. Any dislocation needs to be reduced urgently to prevent complications such as ischaemia.</td>
</tr>
<tr>
<td>meniscus tear</td>
<td>men-IS-kus tear</td>
<td>A tear to the meniscus may be a traumatic injury, commonly seen in athletes, when a knee joint is bent then twisted. It often occurs in conjunction with an anterior cruciate and medial cruciate ligament tear. It can also be part of the degenerative process in older patients who have more brittle cartilage. The most common symptoms of a meniscus tear are swelling and pain in the knee, tenderness on palpation of the meniscus, popping or clicking within the knee and limited range of motion of the knee joint. A tear is diagnosed by MRI or by arthroscopy. Treatment consists of ice packs and rest (conservative treatment) or meniscus repair.</td>
</tr>
<tr>
<td>rotator cuff</td>
<td>roh-TAY-ta kuf SIN-drohm</td>
<td>Rotator cuff syndrome occurs when there is a tear or impingement of the tendons or muscles in the shoulder. The supraspinatus tendon is the most common one to tear. This is often as a result of an acute trauma or age-related degeneration. In some patients there is no pain. In others it feels like a dull ache in the shoulder and may make sleep difficult while others experience severe debility. Impingement syndrome may cause pain when raising the arm to the front or to the side. Conservative treatments such as analgesic medication, rest, hot/cold packs and physiotherapy are the initial treatment options. If the condition persists, a surgical procedure called a rotator cuff repair may be performed.</td>
</tr>
<tr>
<td>sprain</td>
<td>sprayn</td>
<td>A sprain occurs when a ligament is overstretched or torn due to trauma to the joint. The most common site affected is the ankle. There is no fracture or dislocation present. It can result in pain, swelling, joint instability and loss of function. Rest, application of ice and a compression bandage are effective treatments.</td>
</tr>
</tbody>
</table>
Introduction

- There are more than *650* muscles in the human body, which together compose around half of the body weight of the average human.
- Muscle tissue is made up of cells that are called **fibres**.
- Depending on their purpose, the size and shape of the fibres differs.
- The fibres are surrounded by connective tissue and are enclosed in fascia, a type of strong connective tissue.
- As the muscle fibres contract and relax, they produce movement in the body.
- Many body movements are a result of several muscles working collaboratively.
Muscles are often grouped in pairs, where a contraction of one muscle moves a bone in a direction, and a contraction of the other muscle moves the bone in the opposite direction.

The biceps and triceps muscles of the upper arm are a good example of this mechanism.

When the central nervous system instructs the biceps muscle to contract, a corresponding impulse relaxes the triceps muscle, and vice versa.

Occurring at the same time, these impulses allow for movement in both directions.

Muscles can be attached to bones, to skin or to other muscles by tendons and aponeuroses.

Tendons are thick fibrous bands of tissue, whereas aponeuroses are more like flat ribbons, having fewer blood vessels and nerves than tendons.

The body regions with aponeuroses are in the ventral abdominal region, the dorsal lumbar region, and in the palm of the hand.
Combining Form

<table>
<thead>
<tr>
<th>Combining form</th>
<th>Meaning</th>
<th>Medical term</th>
<th>Meaning of medical term</th>
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</thead>
<tbody>
<tr>
<td>clon/o</td>
<td>turmoil</td>
<td>clonic</td>
<td></td>
</tr>
<tr>
<td>dors/o</td>
<td>back (of body)</td>
<td>dorsodynia</td>
<td></td>
</tr>
<tr>
<td>fasci/o</td>
<td>fascia (a band)</td>
<td>fasciectomy</td>
<td></td>
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<tr>
<td>fibr/o</td>
<td>fibre</td>
<td>fibromyalgia</td>
<td></td>
</tr>
<tr>
<td>fibros/o</td>
<td>fibrous connective tissue</td>
<td>fibrosis</td>
<td></td>
</tr>
<tr>
<td>kinesi/o</td>
<td>movement, motion</td>
<td>kinesiologist</td>
<td></td>
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<tr>
<td>lei/o</td>
<td>smooth muscle</td>
<td>leiocutis</td>
<td></td>
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<tr>
<td>leiomy/o</td>
<td>leiomyoma</td>
<td></td>
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<tr>
<td>muscul/i</td>
<td>muscle</td>
<td>muscular</td>
<td></td>
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<tr>
<td>my/o</td>
<td>muscle</td>
<td>myofascial</td>
<td>myositis</td>
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<tr>
<td>myos/i</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>plant/o</td>
<td>sole of the foot</td>
<td>plantar</td>
<td></td>
</tr>
<tr>
<td>rhabd/o</td>
<td>rod shaped, striated (skeletal)</td>
<td>rhabdomyosarcoma</td>
<td></td>
</tr>
<tr>
<td>tax/o</td>
<td>order, coordination</td>
<td>ataxia</td>
<td></td>
</tr>
<tr>
<td>ten/o</td>
<td>tendon</td>
<td>tenorrhaphy</td>
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<tr>
<td>tend/o</td>
<td>tendon</td>
<td>tendolysis</td>
<td></td>
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<tr>
<td>tendin/o</td>
<td>tendon</td>
<td>tendinitis</td>
<td></td>
</tr>
<tr>
<td>ton/o</td>
<td>tone, tension, pressure</td>
<td>myotonia</td>
<td></td>
</tr>
<tr>
<td>tort/i</td>
<td>twisted</td>
<td>torticollis</td>
<td></td>
</tr>
<tr>
<td>Prefix</td>
<td>Meaning</td>
<td>Medical term</td>
<td>Meaning of medical term</td>
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<tr>
<td>ab-</td>
<td>away from</td>
<td>abductor</td>
<td></td>
</tr>
<tr>
<td>ad-</td>
<td>toward</td>
<td>adductor</td>
<td></td>
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<tr>
<td>dorsi-</td>
<td>back</td>
<td>dorsiflect</td>
<td></td>
</tr>
<tr>
<td>poly-</td>
<td>many, much</td>
<td>polymyalgia</td>
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</table>
### Suffix

<table>
<thead>
<tr>
<th>Suffix</th>
<th>Meaning</th>
<th>Medical term</th>
<th>Meaning of medical term</th>
</tr>
</thead>
<tbody>
<tr>
<td>-asthenia</td>
<td>condition of weakness</td>
<td>myasthenia</td>
<td></td>
</tr>
<tr>
<td>-trophyl</td>
<td>development, nourishment</td>
<td>atrophy</td>
<td></td>
</tr>
</tbody>
</table>
# Pronunciation

<table>
<thead>
<tr>
<th>Term</th>
<th>Pronunciation</th>
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</thead>
<tbody>
<tr>
<td>aponeurosis</td>
<td>ap-on-yoo-ROH-sis</td>
</tr>
<tr>
<td>cardiac muscle</td>
<td>KAH-dee-ak MUS-eh</td>
</tr>
<tr>
<td>fascia</td>
<td>FASH-ee-a</td>
</tr>
<tr>
<td>fibromyalgia</td>
<td>fybroh-my-Al-jee-a</td>
</tr>
<tr>
<td>involuntary muscle</td>
<td>in-VOL-un-tery MUS-eh</td>
</tr>
<tr>
<td>muscular dystrophy</td>
<td>MUS-kyoo-lah DIS-troh-fee</td>
</tr>
<tr>
<td>myasthenia gravis</td>
<td>my-as-THEEN-ee-ah GRA-vis</td>
</tr>
<tr>
<td>polymyositis</td>
<td>pol-ee-my-oh-SY-tis</td>
</tr>
<tr>
<td>skeletal muscle</td>
<td>ske-LEE-tal MUS-eh</td>
</tr>
<tr>
<td>smooth muscle</td>
<td>smooth MUS-eh</td>
</tr>
<tr>
<td>strain</td>
<td>strayn</td>
</tr>
<tr>
<td>striated</td>
<td>stry-AY-ted</td>
</tr>
<tr>
<td>tendon</td>
<td>TEN-don</td>
</tr>
<tr>
<td>voluntary muscle</td>
<td>VOL-un-terry MUS-eh</td>
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</table>
## Abbreviation

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
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<tbody>
<tr>
<td>DMD</td>
<td>Duchenne's muscular dystrophy</td>
</tr>
<tr>
<td>EMG</td>
<td>electromyogram</td>
</tr>
<tr>
<td>IM</td>
<td>intramuscular</td>
</tr>
</tbody>
</table>
Skeletal muscle attaches to bones by tendons across a connecting joint, which allows the muscles to pull on bones and create **movement**.

Skeletal muscle is **striated** in appearance; that is, the cell fibres have alternating light and dark bands (known as striations).

Skeletal muscles are under the conscious control of the body, in other words, they are **voluntary muscles**.

These muscles hold the skeleton together, give the body **shape**, and help it with everyday movements by contracting or tightening.

Skeletal muscles vary considerably in size, shape and arrangement of fibres.

The smallest muscles in the body are found in the inner ear and the largest and most bulky is the muscle in the buttock.
▪ Smooth muscles are commonly involved in involuntary movements over which we have no conscious control.

▪ Smooth muscles are formed from thin layers or sheets made up of cells and are found in the walls of the **internal organs**, such as the stomach, intestine, bladder and blood vessels (excluding the heart).

▪ Smooth muscles are **not striated**.
Cardiac muscles are unique in that they are striated in appearance but involuntary in action.

As the name implies, cardiac muscles are found in the myocardium of the heart and largely make up the heart wall.

This type of muscle contracts to force blood out of the heart into the blood vessels and relaxes to allow the heart to fill with blood.

Cardiac Muscle
Skeletal Muscle Fibers

- Each one of skeletal muscles is made up of hundreds to thousands of **muscle fibers** that are tightly wrapped together by connective tissue.
- Each muscle fiber contains smaller units made up of repeating thick and thin **filaments**.
- This causes the muscle tissue to be striated or have a striped appearance.
- Skeletal muscle fibers are classified into two types:
  - **Type 1**
    - These fibers utilize oxygen to generate energy for movement.
    - These fibers have a higher density of energy-generating organelles called mitochondria, and this makes them dark.
  - **Type 2-A**
    - Like type 1 fibers, type 2A fibers can also use oxygen to generate energy for movement.
    - However, they contain less mitochondria, making them light.
  - **Type 2-B**
    - Type 2B fibers do not use oxygen to generate energy.
    - Instead, they store energy that can be used for short bursts of movement.
    - They contain even less mitochondria than type 2A fibers and appear white.
Smooth & Cardiac Muscle Fibers

- **Smooth muscle** fibers have an oblong shape, much like a football.
- They’re also thousands of times shorter than skeletal muscle fibers.
- **Cardiac muscle** fibers have their own rhythm.
- Special cells, called pacemaker cells, generate the impulses that cause cardiac muscle to contract.
- This typically happens at a constant pace but can also speed up or slow down as necessary.
- Cardiac muscle fibers are branched and interconnected.
- When the pacemaker cells generate an impulse, it spreads in an organized, wavelike pattern, which facilitates the beating of your heart.
Attachments of Skeletal Muscles

- **Origin**
  - Least movable
  - Mostly fleshy
  - Proximal end

- **Insertion**
  - Most movable
  - Mostly fibrous
  - Distal end
Types of Attachments

- **Tendons**
  - A tough cord of fibrous connective tissue that usually connects muscle to bone and is capable of withstanding tension.

- **Aponeurosis**
  - A thin broad and strong sheet of fibrous tissue.

- **Raphe**
  - An interdigitation of the tendinous ends of the flat muscles.
  - Example: mylohyoid raphe
Directions of Muscle Fibers

- **Parallel to line**
  - More range of movement, less powerful.

- **Pennate (oblique to line)**
  - More powerful, less range of movement.
    - Unipennate
    - Bipennate
    - Multipennate

- **Fusiform**
  - Spindle-shaped (round, thick belly, & tapered ends).

- **Circular**
  - Surround a body opening or orifice, constricting it when contracted.

- **Triangular**
  - Have a broad attachment from which the fascicles converge to a single tendon.
Mode of Actions

- **Prime mover (Agonist)**
  - It is the chief muscle responsible for a particular movement.
    - **Example**: Biceps Brachii is the prime mover for flexion of the elbow joint and forearm.

- **Antagonist**
  - It opposes the action of the prime mover.
  - Before contraction of prime mover, antagonist must be relaxed.
    - **Example**: Triceps Brachii is the antagonist for prime mover for extension of the elbow joint and forearm.

- **Synergist**
  - Muscles that assist the prime mover in a particular movement.
    - **Example**: Brachialis muscle for Biceps prime mover muscle.

- **Fixator**
  - Its contraction does not produce movement by itself but it stabilizes the origin of the prime mover so that it can act efficiently.
    - **Example**: Deltoid muscle for Biceps prime mover muscle.
Naming of Muscles

- **Size**
  - Major or Maximus (large)
  - Minor or Minimus (small)
  - Latissimus (broad)
  - Longus (long)
  - Brevis (short)

- **Position**
  - Pectoralis (pectoral region)

- **Depth**
  - Superficialis (superficial)
  - Profundus (deep)
  - Externus (external)

- **Shape:**
  - Deltoid (triangular)
  - Teres (rounded)
  - Rectus (straight)

- **Number of Heads:**
  - Biceps (2 heads)
  - Triceps (3 heads)
  - Quadriceps (4 heads)

- **Attachments:**
  - Coracobrachialis

- **Action:**
  - Flexor digitorum: flexion of digits
Muscle and muscles fibers work to cause movement in the body.

The first thing that occurs is something called **depolarization**.

Depolarization is a change in electric charge.

It can be initiated by a stimulatory input like a nerve impulse or, in the case of the heart, by pacemaker cells.

Depolarization leads to a complex chain reaction within muscle fibers.

This eventually leads to a release of energy, resulting in muscle contraction.

Muscles relax when they stop receiving a stimulatory input.
Fast and Slow Twitch

- Fast-twitch and slow-twitch refer to skeletal muscle fibers and refer also to how fast muscles contract.
- Types 2-A and 2-B are FT while type 1 fibers are ST.
- The speed at which a muscle contracts is determined by how quickly it acts on ATP.
- ATP is a molecule that releases energy when it’s broken down.
- FT fibers break down ATP twice as fast as ST fibers.
- Additionally, fibers that use oxygen to produce energy (ATP) fatigue at a slower rate than those that don’t.
- So as far as endurance is concerned, the skeletal muscles listed from highest to lowest are:
  - type 1
  - type 2A
  - type 2B
Fast and Slow Twitch

- **ST** fibers are good for long lasting activities.
- These can include things like holding a posture and stabilizing bones and joints.
- They're also used in endurance activities, such as running, cycling, or swimming.
- **FT** fibers produce shorter, more explosive bursts of energy.
- Because of this, they're good in activities involving bursts of energy or strength.
- Examples include sprinting and weightlifting.
- Everyone has both FT and ST muscles throughout their body.
- However, the overall amount of each varies greatly between individuals.
- FT versus ST composition can also influence athletics.
- Endurance athletes often have more ST fibers, while athletes like sprinters or power-lifters often have more FT fibers.
Pathology & Diseases
Fibromyalgia is a term used to describe a common syndrome in which people experience long-term, widespread pain and tender points in joints, muscles, tendons and other soft tissues.

- It also results in disturbed sleep and exhaustion.

- The cause is unknown but possible triggers include viral infection, physical and emotional stress.

- It tends to be more common in people with pre-existing lupus, rheumatoid arthritis, or ankylosing spondylitis.

- There is no cure but symptomatic treatment can help some patients.

Fibromyalgia
▪ A muscle cramp is a sudden and involuntary contraction of one or more of your muscles.
▪ If you've ever been awakened in the night or stopped in your tracks, you know that muscle cramps can cause severe pain.
▪ Though generally harmless, muscle cramps can make it temporarily impossible to use the affected muscle.
▪ Long periods of exercise or physical labor, particularly in hot weather, can lead to muscle cramps.
▪ Some medications and certain medical conditions also may cause muscle cramps.
▪ Overuse of a muscle, dehydration, muscle strain or simply holding a position for a prolonged period can cause a muscle cramp.
▪ Factors that might increase your risk of muscle cramps include age, dehydration, pregnancy and medical conditions.
▪ You might be at higher risk of muscle cramps if you have diabetes, or nerve, liver or thyroid disorders.
Muscular dystrophy (MD) refers to a group of hereditary diseases that weaken different muscle groups in various ways.

A person affected with MD has a genetic mutation that prevents the repair of muscle tissue.

This muscle weakening occurs gradually over time.

Symptoms may start at any time from infancy through to adulthood.

The most common form of muscular dystrophy is Duchenne’s muscular dystrophy (DMD).

It is caused by a genetic defect, which results in the body’s failure to produce a specific protein called dystrophin.

It predominantly affects boys between the ages of 2 and 6 years.

By age 10 to 12 years these children will often be in a wheelchair.

This disease also affects other body systems so patients need regular respiratory and cardiac assessment.

It is likely that these patients will eventually need a ventilator to breathe.

People with DMD usually do not survive beyond their late teens or early adulthood.
Paralysis is the loss of muscle function in part of your body. It happens when something goes wrong with the way messages pass between your brain and muscles. Paralysis can be complete or partial. It can occur on one or both sides of your body. It can also occur in just one area, or it can be widespread. Paralysis of the lower half of your body, including both legs, is called paraplegia. Paralysis of the arms and legs is quadriplegia. Most paralysis is due to strokes or injuries such as spinal cord injury or a broken neck.
These actually happen due to conditions affecting the nerves. These conditions can go on to affect skeletal muscles, leading to weakness or paralysis. Examples include Bell’s palsy and Guyon canal syndrome.
A strain occurs when a muscle and/or tendon is overstretched or torn.
- There is no fracture or dislocation present.
- Pain, weakness and muscle spasms are common symptoms experienced after a strain occurs.
- Rest, application of ice and a compression bandage are effective treatments.

Strain
<table>
<thead>
<tr>
<th>Term</th>
<th>Pronunciation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>muscular dystrophy</td>
<td>mūs-kyoo-ūl DIS-trof-ee</td>
<td>Muscular dystrophy (MD) refers to a group of hereditary diseases that weaken different muscle groups in various ways. A person affected with MD has a genetic mutation that prevents the repair of muscle tissue. This muscle weakening occurs gradually over time. Symptoms may start at any time from infancy through to adulthood. The most common form of muscular dystrophy is Duchenne's muscular dystrophy (DMD). It is caused by a genetic defect, which results in the body's failure to produce a specific protein called dystrophin. It predominantly affects boys between the ages of 2 and 6 years. By age 10 to 12 years, these children will often be in a wheelchair. This disease also affects other body systems so patients need regular respiratory and cardiac assessment. It is likely that these patients will eventually need a ventilator to breathe. People with DMD usually do not survive beyond their late teens or early adulthood.</td>
</tr>
<tr>
<td>myasthenia gravis</td>
<td>my-as-THÉ-ne-a GRA-vis</td>
<td>Myasthenia gravis is an autoimmune, neuromuscular disorder that causes weakness of the voluntary (skeletal) muscles. The flow of impulses between nerves and muscles is compromised. It can occur at any age but predominantly affects young women and older men. Muscle weakness becomes worse with activity but improves with rest. Patients with myasthenia gravis will experience dyspnoea, dysphagia, facial paralysis, diplopia, blepharoptosis and general fatigue. There is currently no cure but treatment can help alleviate some of the symptoms. Medications, plasmapheresis, intravenous immunoglobulins and lifestyle adjustments to allow for more rest can all improve quality of life.</td>
</tr>
<tr>
<td>polymyositis</td>
<td>pol-ee-my-oh-SY-tis</td>
<td>Polymyositis is an inflammatory muscle disease that results in muscle weakness. The cause is unknown; however, it is thought to be triggered by environmental agents such as viruses. Other research indicates an autoimmune or genetic etiology. Polymyositis is often associated with autoimmune diseases such as rheumatoid arthritis and lupus erythematosus. It is more common in females than males and tends to develop between the ages of 50 and 70 years. Most patients experience an improvement of their symptoms with treatment such as corticosteroids; although there may be some long-term muscle weakness. It is rarely fatal, but it has been linked with respiratory and cardiac conditions, as well as an increased risk of certain cancers, such as bladder cancer and non-Hodgkin's lymphoma.</td>
</tr>
<tr>
<td>strain</td>
<td>strain</td>
<td>A strain occurs when a muscle and/or tendon is overstretched or torn. There is no fracture or dislocation present. Pain, weakness and muscle spasms are common symptoms experienced after a strain occurs. Rest, application of ice and a compression bandage are effective treatments.</td>
</tr>
</tbody>
</table>
Muscle Treatments

- Minor muscle injuries may be treated with simple home remedies, such as rest, applying ice, using compression bandage, and elevating your injured limb.
- Anti-inflammatory medication.
- Physiotherapy
- Severe muscle injuries need to be checked by a qualified health care provider.
- A torn muscle or tendon may need to be surgically repaired.
<table>
<thead>
<tr>
<th>Test/Procedure</th>
<th>Pronunciation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>amputation</td>
<td>am-poo-THAM-ee</td>
<td>An amputation is the surgical or traumatic removal/eduction of an extremity (arm, hand, finger, leg, foot, toe). In addition to traumatic amputations, some of the common reasons leading to the need for amputation include diabetes, peripheral vascular disease and cancer.</td>
</tr>
<tr>
<td>antinuclear antibody test (ANA)</td>
<td>AN-tee-nyoo-layb ree-test</td>
<td>ANA is a diagnostic test used in patients with systemic lupus erythematosus (SLE) or lupus to detect antibodies present in the patient's serum.</td>
</tr>
<tr>
<td>arthrocentesis</td>
<td>ar-throe-sen-TEE-ee</td>
<td>An arthrocentesis is also known as joint aspiration. A needle is inserted into the joint to withdraw synovial fluid for the purpose of relieving joint pain and swelling or for analysis to identify conditions such as infection, rheumatoid arthritis and gout.</td>
</tr>
<tr>
<td>arthrography</td>
<td>ar-throe-GRAFE-ee</td>
<td>An arthrography involves the injection of contrast material containing iodine into a joint to allow for an x-ray called a fluoroscopy to be performed. It is used to identify abnormalities with the function and structure of a joint and to determine the need for further treatment and surgery.</td>
</tr>
<tr>
<td>arthropathy</td>
<td>ARTH-roh-play-tee</td>
<td>An arthropathy is a surgical procedure that leads to the reconstruction or replacement of joint structures with artificial devices. The procedure is performed to relieve the symptoms of pain from conditions such as osteoarthritis. Arthropathy of the knee or hip are the most common. Total or partial replacement may be performed, e.g. a hemiarthroplasty is commonly performed for a fractured neck of femur.</td>
</tr>
<tr>
<td>arthroscopy</td>
<td>ARTH-ROSS-kope-ee</td>
<td>An arthroscopy is a procedure to view a joint using an arthroscope. The procedure is used both as a diagnostic process and as a method of entry to allow for more complex procedures such as a meniscectomy.</td>
</tr>
</tbody>
</table>

Figure 4.8 Arthroscopy (Leonard, 2005)

- Quadriceps femoris
- Head of femur
- Synovial space

Bone density test is a diagnostic procedure used to identify decreased bone density. The test identifies conditions such as osteoporosis and osteopenia. Generally, x-rays of the spinal column, pelvis and wrist are taken to measure the density of the bones.
<table>
<thead>
<tr>
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<td>an-tee-NYOD-lee-a AN-tee-bod-ee test</td>
<td>An ANA is a diagnostic test used in patients with systemic lupus erythematosus (SLE or lupus) to detect antibodies present in the patient's serum.</td>
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<td>ar-thro-SEN-TEE-sis</td>
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<td>arthroplasty</td>
<td>ARTH-oh-plas-tee</td>
<td>An arthroplasty is a surgical procedure that leads to the reconstruction or replacement of joint structures with artificial devices. The procedure is performed to relieve the symptoms of pain from conditions such as osteoarthritis. Arthroplasty of the knee or hip are the most common. Total or partial replacement may be performed, e.g. a hemiarthroplasty is commonly performed for a fractured neck of femur.</td>
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<td>ar-thro-ROSS-kop-ee</td>
<td>An arthroscopy is a procedure to view a joint using an arthroscope. The procedure is used both as a diagnostic process and as a method of entry to allow for more complex procedures such as a meniscectomy.</td>
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</table>

Figure 4.8 Arthroscopy
(Leonard, 2006)
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<thead>
<tr>
<th>Test/Procedure</th>
<th>Pronunciation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>magnetic resonance imaging (MRI)</td>
<td>mag. NET-ik REZ-on-ans IM-a-jing</td>
<td>An MRI is a diagnostic test that creates images of soft tissue using radio waves and a magnetic field.</td>
</tr>
<tr>
<td>meniscectomy</td>
<td>man-i-SEK-teh-mee</td>
<td>A meniscectomy is a surgical procedure that involves removal of damaged meniscal tissue in the knee. The route for entry is generally via arthroscopy.</td>
</tr>
<tr>
<td>muscle biopsy</td>
<td>MUS-eh BY-op-see</td>
<td>A muscle biopsy is a diagnostic procedure involving the excision of a sample of muscle for laboratory examination.</td>
</tr>
<tr>
<td>reduction and fixation</td>
<td>re-DUK-shun and fik-SAY-shun</td>
<td>This group of procedures generally refers to the manipulation of a bone or joint following a dislocation or fracture to correct its position and the subsequent process of securing the structure with screws, wires, pins or plates. The reduction can be accomplished either as a closed (non-surgical incision) procedure or open (a surgical incision is required to access the fracture or dislocation) procedure. For those fractures and dislocations that require fixation, the procedure can involve internal or external fixation. Internal fixation involves the use of fixtures such as pins, bone screws, wires, rods and plates that are used to support the structure whilst healing occurs. External fixation involves the placement of pins and screws which are then secured to a frame on the outside of the skin.</td>
</tr>
<tr>
<td>rheumatoid factor test (RFT)</td>
<td>ROO-ma-toid FAK-ta test</td>
<td>An RFT test is a diagnostic test used in patients with rheumatoid arthritis to detect antibodies present in the patient's serum.</td>
</tr>
<tr>
<td>serum calcium (Ca)</td>
<td>SEE-num KAL-see-un</td>
<td>A serum Ca test is a diagnostic test to identify the levels of calcium in serum. It is used to identify the presence of hypercalcaemia or hypocalcaemia.</td>
</tr>
<tr>
<td>serum creatine kinase (CK)</td>
<td>SEE-num KREEAT-in RAY-naze</td>
<td>A serum CK test is a diagnostic test to identify increased levels of the enzyme creatine kinase in serum which is present in the conditions polymyositis, muscular dystrophy and traumatic muscular injuries.</td>
</tr>
<tr>
<td>computed tomography (CT)</td>
<td>kom-PYOO-loyd to-MOG-raff</td>
<td>A CT is a diagnostic test performed to identify disorders of the soft tissues, bone and muscle. Cross-sectional images are taken using a computer in conjunction with x-ray beams.</td>
</tr>
<tr>
<td>electromyography (EMG)</td>
<td>ee-LEK-troh-my-OG-raff</td>
<td>An EMG is a diagnostic test used to identify neuropaenic and myopathic disorders. Electrodes are placed on the muscle and are used to record motor unit activity at rest and also during muscle contraction.</td>
</tr>
<tr>
<td>erythrocyte sedimentation rate (ESR)</td>
<td>e-REE-th roh-syt SEE-ee-men-TAY-shun raft</td>
<td>ESR is a measure to determine the rate at which erythrocytes settle out of plasma in a test tube. In diseases such as infections, joint inflammation and tumours that increase the immunoglobulin content of blood, the sedimentation rate is altered.</td>
</tr>
<tr>
<td>joint injection</td>
<td>jooynt in-JEK-shun</td>
<td>A joint injection is a method of treatment using a hypodermic needle to inject anti-inflammatory agents into a joint to treat such conditions as arthritis, gout, and tendinitis.</td>
</tr>
<tr>
<td>laminectomy</td>
<td>lam-in-EK-tom-ee</td>
<td>A laminectomy is a surgical procedure that involves incising a vertebra to allow access to the spinal cord to remove herniated intervertebral discs and tumours. It is also used to relieve pressure on a spinal nerve.</td>
</tr>
</tbody>
</table>
CARTILAGE
Cartilage is a flexible connective tissue found in multiple organ systems of the body.

Cartilage is composed of specialized cells called chondrocytes, collagen fibers and abundant ground substance rich in proteoglycan and elastin fibers.

The musculoskeletal system specifically contains articular cartilage, a type of cartilage that lines the articulating surfaces of bones.

The articular cartilage provides congruence to the articulating bones and allows them to bear weight and glide over each other with very little friction.

Structure
Classification

- **Hyaline cartilage**
  - Composed of type II collagen and it gives a glossy appearance.
  - It is the most common type of cartilage found in joints (articular cartilage), as well as the nose, larynx, trachea and ribs.

- **Elastic cartilage**
  - Similar to hyaline cartilage but contains more elastic fibers.
  - It is found in structures such as the pinna of the ear, auditory tube and epiglottis.

- **Fibrocartilage**
  - Composed of plenty of collagen fibers type I.
  - Examples of fibrocartilage include intervertebral discs, pubic and other symphyses.
LIGAMENTS
Ligaments are fibrous bands made of dense regular connective tissue which are similar in structure to tendons.

Unlike the tendons that connect muscles to bone, the ligaments connect bone to bone.

Besides the musculoskeletal system, the ligaments are also found in many other parts of the body, where they usually stabilize and hold internal organs in place and transmit neurovascular structures.

In the musculoskeletal system, ligaments stabilize the articulating bones and reinforce the joints.
Classification

- **Capsular ligaments**
  - Essentially thickenings of the joint capsule that form either elongated bands or triangular structures.
  - These ligaments serve to reinforce the integrity of the joint capsule.
  - An example of the capsular ligament is the iliofemoral ligament of the hip joint.

- **Intracapsular ligaments**
  - The ligaments that lie internal to the joint capsule.
  - These ligaments reinforce the connection of the articulating surfaces of the joint but allow a far wider range of motion than other ligaments.
  - Examples include anterior and posterior cruciate ligament of the knee joint.

- **Extracapsular ligaments**
  - Ligaments that lie outside the joint capsule.
  - These ligaments provide the most stability to the articulating bones and are important for preventing dislocations.
  - Extracapsular ligaments can lie in close proximity (e.g. medial collateral ligament of the ankle joint) or a bit further from the joint capsule (vertebral ligaments).
A sprain occurs when a ligament is overstretched or torn due to trauma to the joint.

- The most common site affected is the ankle.
- There is no fracture or dislocation present.
- It can result in pain, swelling, joint instability and loss of function.
- Rest, application of ice and a compression bandage are effective treatments.
BURSAE
Bursae are small sac-like outpouchings of the joint cavity lined by synovial membrane.

They are found around the joints, providing cushioning of the associated bones, tendons and muscles and reducing friction between adjacent structures.

The majority of synovial bursae are located near the large joints of the arms and legs.

For example, one of the bursae of the knee joint is the suprapatellar bursa, found superior to the patella, between the femur and the tendon of the quadriceps femoris muscle.

The suprapatellar bursa allows for these structures to slide over each other without friction during flexion and extension of the knee joint.
Bursitis

- **Bursitis** is inflammation of a bursa (a fibrous fluid-filled sac between a tendon and bone).
- Normally, the bursa provides a slippery surface that assists movement and reduces friction.
- When a bursa becomes inflamed it results in joint pain, stiffness and swelling around the affected joint.
- Bursitis is caused by chronic overuse, trauma and infection. The most commonly affected joints are the shoulder, elbow, knee and hip.
- Treatment consists of administering NSAIDs such as ibuprofen, physiotherapy and rest as required.
- In some cases an injection of a corticosteroid into the joint is required.
TENDONS
- A tendon is a tough, flexible band of dense connective tissue that serves to attach skeletal muscles to bones.
- They are found at the distal and proximal ends of muscles, binding them to the periosteum of bones at their proximal (origin) and distal attachment (insertion) on the bone.
- As muscles contract, the tendons transmit the mechanical force to the bones, pulling them and causing movement.
- Being made of dense regular connective tissue, the tendons have an abundance of parallel collagen fibers, which provide them with high tensile strength (resistance to longitudinal force).
Exercises
EXERCISES

Exercise 4.1: Label the Diagrams

Using the information provided in this chapter, label the anatomical parts in the figures below:

1. 
2. 
3. 
4. 
5. 
6. 
7. 
8. 
9. 
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16. 
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32. 
33. 
34. 
35. 
36. 

Figure 4.18A
(McAulay's Dictionary, 2016)
Exercise 4.2: Word Analysis and Meaning

Break up the medical terms below into their component parts (prefixes, suffixes, word roots, combining vowels). Provide the meaning for each word element and each term as a whole.

Example:
osteomalacia
oste/o = bone
mal/o = pertaining to softening
Meaning = pertaining to softening of bone

1. costovertebral

2. arthroscopy

3. osteogenic

4. bursitis

5. meniscectomy

6. polymyxin

7. intervertebral
Exercise 4.3: Match Word Elements and Meanings

Match the prefix, suffix or word root in Column A with its meaning from Column B.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Answer</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. spond/o</td>
<td></td>
<td>A. cleavage</td>
</tr>
<tr>
<td>2. -thesis</td>
<td></td>
<td>B. joint</td>
</tr>
<tr>
<td>3. sci/o</td>
<td></td>
<td>C. to bind, surgical fixation or fusion</td>
</tr>
<tr>
<td>4. lumb/o</td>
<td></td>
<td>D. vertebra</td>
</tr>
<tr>
<td>5. -dist</td>
<td></td>
<td>E. slip or slide</td>
</tr>
<tr>
<td>6. articul/o</td>
<td></td>
<td>F. rod shaped, striated</td>
</tr>
<tr>
<td>7. rhul/o</td>
<td></td>
<td>G. crooked or bent</td>
</tr>
<tr>
<td>8. clino/o</td>
<td></td>
<td>H. narrowing or stricture</td>
</tr>
<tr>
<td>9. tort/o</td>
<td></td>
<td>I. smooth</td>
</tr>
<tr>
<td>10. lumb/o</td>
<td></td>
<td>J. weakness</td>
</tr>
<tr>
<td>11. -stenosis</td>
<td></td>
<td>K. loin, lower-back</td>
</tr>
<tr>
<td>12. -stenia</td>
<td></td>
<td>L. twisted</td>
</tr>
</tbody>
</table>
### Exercise 4.4: Match Medical Terms and Meanings

Match the medical term in Column A with its meaning in Column B.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Answer</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. metatarsals</td>
<td>A. kneecap</td>
<td></td>
</tr>
<tr>
<td>2. radius</td>
<td>B. bones of the toes</td>
<td></td>
</tr>
<tr>
<td>3. occipital bone</td>
<td>C. thigh bone</td>
<td></td>
</tr>
<tr>
<td>4. fibula</td>
<td>D. breastbone</td>
<td></td>
</tr>
<tr>
<td>5. patella</td>
<td>E. lower jaw</td>
<td></td>
</tr>
<tr>
<td>6. ischium</td>
<td>F. chiilbebone</td>
<td></td>
</tr>
<tr>
<td>7. femur</td>
<td>G. back of the skull</td>
<td></td>
</tr>
<tr>
<td>8. calcaneus</td>
<td>H. outer, thinner bone of lower leg</td>
<td></td>
</tr>
<tr>
<td>9. zygoma</td>
<td>I. part of the nasal cavity</td>
<td></td>
</tr>
<tr>
<td>10. sternum</td>
<td>J. part of the pelvis</td>
<td></td>
</tr>
<tr>
<td>11. mandible</td>
<td>K. outer bone of the forearms</td>
<td></td>
</tr>
<tr>
<td>12. ethmoid</td>
<td>L. heel</td>
<td></td>
</tr>
</tbody>
</table>

### Exercise 4.5: Expand the Abbreviations

Expand the abbreviations to form correct medical terms.

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Expanded abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACL</td>
<td>Anterior Cruciate Ligament</td>
</tr>
<tr>
<td>CT scan</td>
<td>Computed Tomography scan</td>
</tr>
<tr>
<td>CTS</td>
<td>Carpal Tunnel Syndrome</td>
</tr>
<tr>
<td>MRI</td>
<td>Magnetic Resonance Imaging</td>
</tr>
<tr>
<td>NDI</td>
<td>Neck Disability Index</td>
</tr>
<tr>
<td>NSAID</td>
<td>Nonsteroidal Anti-Inflammatory Drugs</td>
</tr>
<tr>
<td>OA</td>
<td>Osteoarthritis</td>
</tr>
<tr>
<td>ORIF</td>
<td>Open Reduction Internal Fixation</td>
</tr>
<tr>
<td>T1-T12</td>
<td>Thoracic vertebrae 1 to 12</td>
</tr>
<tr>
<td>TCR</td>
<td>Tumor Characterization Report</td>
</tr>
</tbody>
</table>
Exercise 4.6: Applying Medical Terminology

Fill in the blank or select the correct medical term or word element.

1. Which of the following is a term for involuntary contraction and relaxation of skeletal muscles?
   a) rigor
   b) spasm
   c) tetany
   d) tremor

2. Osteomyelitis is a condition of the bone and bone marrow causing
   a) death and bone density
   b) vitamin D deficiency
   c) atrophy of skeletal muscle
   d) inflammation

3. Which of the following means: rib?
   a) sterno
   b) costal
   c) ribal
   d) ribalo

4. __________ is a protective covering for internal organs and produces body heat.
   a) pleura
   b) tendons
   c) cartilage
   d) muscles

5. Which of the following is not an inflammation of the musculoskeletal system?
   a) bursitis
   b) chondromalacia
   c) tendositis
   d) epiphysis

6. Softening of the bone is termed __________
   a) osteoporosis
   b) osteomalacia
   c) osteosclerosis
   d) osteoarthritis

7. The clavicle is part of the __________ skeleton.
   a) appendicular
   b) axial

8. A surgical repair of damaged cartilage is __________
   a) arthroplasty
   b) chondroplasty
   c) chondroplasty
   d) osteoplasty

9. A fracture in which the ends of the bones are crushed is a __________ fracture.
   a) compound
   b) comminuted
   c) simple
   d) greenstick

10. What term means slowing of movement?
    a) hypotonia
    b) myotonia
    c) dyssinergia
    d) bradykinesia

Exercise 4.7: Correct the Spelling and Identify the Incorrect Terms.
Identify the medical terms spelled incorrectly or words used inappropriately. Provide the correct terms.

1. There had clearly been atrophy of the upper extremity muscles since the patient’s last attendance at the orthopedic clinic.

2. A spinal x-ray revealed spondylolisthesis and there was forward slipping of the fifth vertebrae of the lumbar spine onto the sacrum.

3. Mr. Jones had bilateral carpal tunnel syndrome. Surgical division of the ligament in the left wrist was undertaken to compress the middle nerve.
Exercise 4.9: Crossword Puzzle

Complete the puzzle by providing the medical term for each of the clues below.

ACROSS
2. tear or impingement of the tendons or muscles in the shoulder (7, 8)
4. x break or crack in a bone (8)
5. connective tissue that provides structure and support to other tissues (9)
8. process of formation of bone (12)
9. an inflammatory muscle disease that results in muscle weakness (13)
10. fixed immovable joint (7)

DOWN
1. cell fibers having alternating light and dark bands (11)
3. fibrous connective tissue that attach muscles to bone; bind muscle together or to other tissue at their point of origin or insertion (11)
6. pertaining to inflammation of a joint (9)
7. s-shaped curvature of the spine (6)
QUESTIONS?

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