Anatomy of the Foot and Lower Extremity

The foot combines mechanical complexity and structural strength. The ankle serves as foundation, shock absorber, and propulsion engine used in the walking process. The foot can sustain enormous pressure and provides flexibility and resiliency. Structurally, the foot has three main parts: the forefoot, the midfoot, and the hindfoot. The foot and ankle contain:

- 26 bones
- 33 joints or articulations
- More than 100 muscles, tendons, and ligaments and a network of blood vessels, nerves, skin and soft tissue

These biological components work together to provide the body with support, balance, and mobility.

Bones and Joints of the Lower Extremity

Bone is a complex multi-purpose organ that consists of connective tissue comprised of a dense organic matrix combined with inorganic mineral components, including calcium and phosphorus, which comprise the ‘skeleton’ of the body. There are 206 bones in the human body, and there are 26 in each of the feet individually. Structures and types of bones, including those in the foot, are as follows:

- Cancellous or Spongy Bone: Soft bone texture primarily present in the heads of bone and near the marrow cavity
- Epiphysis: The end of a long bone, usually wider than the shaft, and either entirely cartilaginous or separated from the shaft by a cartilaginous disk
- Diaphysis: The elongated cylindrical portion (the shaft) of a long bone, between the ends or extremities, which are usually articular and wider than the shaft
- Compact or Dense Bone: Highly vascularized bone tissue found in the diaphysis of the bone
- Periosteum: A specialized connective tissue covering all bones of the body, and possessing bone-forming potentialities
- Medullary Cavity: Pertaining to the marrow of the bone
- Short Bones: Small bones that are generally cuboidal in structure, found primarily in the hands and feet
Between each of these bones is a joint that allows for the movement necessary of each section of the foot. The joints, or articulations, of the foot come in two types. The ankle and the toe joints are typical hinge articulations; that is, the hinge joint allows the ankle and toes to flex and bend up and down and to move forward and backward. The other joints of the foot, those between tarsal bones or between the tarsal and metatarsal bones, are of a gliding nature, one against another. The tarsal and metatarsal bones can move only slightly — except for the ankle, which allows for greater movement. All joints of the foot are protected by a covering of cartilage and are lubricated by synovial fluid. Ligaments of tough elastic fiber connect the bones one to another. A capsule surrounds each articulation and protects the delicate structures within.

**Joint Classifications:**

- **Synarthrosis:** An immovable articulation in which the bony elements are united by continuous intervening fibrous tissue (e.g.: joints between the teeth and jaw bones)
- **Amphiarthrosis:** A form of articulation permitting little motion (e.g.: pubic symphysis)
- **Diarthrosis:** A movable joint (e.g.: synovial joints)
- **Joint Capsule:** A structure in which the diarthrostic or synovial joint is encased. Composed of fibrous and synovial membranes, the joint capsule attaches the ends of the articulations together
- **Joint Cavity:** The enclosed, fluid-filled space inside the joint capsule that allows the two bones of the joint to move against each other with little or no friction, due to the presence of synovial fluid within the cavity

**Forefoot**

**Bones of the forefoot**

- Five metatarsals: metatarsals are the long bones that connect the midfoot to the phalanges
- Two sesamoid bones: Small round bones that are embedded in the tendons on the plantar side of the first metatarsal head
- Five phalanges: Phalanges are small long bones that form the toes
  - Four lesser toes which consist of three bones each, the proximal, middle, and distal phalanges
  - The great toe, which consists of only the proximal and distal phalanges.
- Rays: The metatarsals and phalanges combined form a Ray, i.e., the First ray is the first metatarsal and the hallux (big toe)
The joints of the forefoot are:
- **Metatarsal phalangeal joint (MTP joint):** Between the metatarsal and the proximal phalanx of the adjacent toe.
- **Proximal interphalangeal joint (PIP joint):** Between the proximal phalanx and the middle phalanx of each toe.
- **Distal interphalangeal joint (DIP joint):** Between the middle phalanx and the distal phalanx of each toe.
- The big toe (Great toe) has only one joint between its two phalanges and therefore this joint is called the great (or “big”) toe interphalangeal joint.
- **Metatarsal head:** The end of the metatarsals, which articulate, with the joints of the adjacent bones – generally used to describe the distal metatarsal head.

### Midfoot

**Bones of the Midfoot**
The midfoot has five irregularly shaped tarsal bones, forms the foot’s arch, and serves as a shock absorber. The bones of the midfoot are connected to the forefoot and the hindfoot by muscles and the plantar fascia (arch ligament).
- **Navicular:** Small boat shaped bone found on the medial side of the foot adjacent to the cuboid bone, and proximal to the cuneiform bones.
- **Cuboid:** Cube shaped bone found on the lateral side of the foot just proximal to the base of the 5th metatarsal head, and adjacent to the cuneiform bones.
- Cuneiform bones (3): There are three cuneiform bones, which are located at the lateral, middle, and medial segments of the midfoot. They are distal to the navicular and proximal to the 1st, 2nd, and 3rd metatarsals.

**Joints of the Midfoot**

Tarsometatarsal Joint (TM joint): A multi-joint region that is comprised of the joints between:

- The fourth and fifth metatarsals in their articulation with the cuboid bone
- The first, second and third metatarsals in their articulation with the respective cuneiform bone

Each of these has an individual joint capsule but all are wrapped in one big capsule as well to form the TM joint.

**Hindfoot**

**Bones of the Hindfoot**

The top of the talus is connected to the two long bones of the lower leg (tibia and fibula), forming a hinge that allows the foot to move up and down. The heel bone, or calcaneus, is the largest bone in the foot.

- Talus: Bone that is located proximal to the midfoot and forms the ankle via a connection on the medial side to the tibia, and on the lateral side to the fibula.
Midfoot  • Calcaneus: Also known as the heel bone, it is the largest bone in the foot

Joints of the Hindfoot

The joints of the hindfoot link the midfoot to the ankle

- Midtarsal joint (MTJ): A combination joint comprised of the calcaneocuboid joint located on the lateral side of the foot, and the talonavicular joint located on the medial side of the foot
- Subtalar joint (STJ): The joint which joins the calcaneus to the talus, and enables the foot to rotate at the ankle
- Talocrural joint (TCJ): The joint which connects the proximal end of the talus to the tibia and fibula, forming the “hinged” ankle joint
Muscles, Ligaments, and Tendons

Muscle (Skeletal): A tough, elastic tissue that is attached at either end to a fixed location and moves or stabilizes a body part via contraction.

Tendon: A tough flexible connective tissue that attaches muscle to the periosteum of the bones.

Ligament: A band or sheet of tough, fibrous connective tissue which attaches two or more bones, cartilages, or other structures as well as providing support for fasciae or muscles.

The foot cannot function without its twenty muscles and the muscles of the lower leg. They bend or extend the toes at the joints, raise or lower the toes singly or in groups, flex the sole of the foot, and in general make possible the great variety of movements or combinations of movements of the foot.

Nearly every foot movement involves some use of the leg muscles. Leg muscles raise your foot to tiptoe positions, rotate your foot, and flex the ankle. The leg muscles balance the leg on the foot by alternately tensing and relaxing first one muscle group and then another. The balancing action causes the body weight to be carried on the strongest structures of the foot — the heel bone, the ankle bone, and the first metatarsals. The leg muscles also counterbalance the forces that develop when the body is thrown off balance; for example when you trip as you walk, those muscles act to restore your balance.

Some foot and leg muscles are matched in pairs: as one stretches, the other contracts. In such cases, long muscles are attached at one end to a bone in the leg and at the other end to a bone in the foot. In most cases, the leg muscle ends in a long tendon that extends through the foot to its point of attachment to the bone.

Muscles end in tendons, fibrous cords of connective tissue that attach muscle to bone. A tendon is surrounded by a sheath of protective material that, in turn, is protected by layers of additional tough fibrous tissue. The achilles tendon is the one best known, it runs from the middle of the back of the leg to the heel bone.

On the bottom of the foot are two groups of fibrous tissue called fasciae. Both those fasciae are long and slim, but strong and tight as a bowstring, run from the heel to the toes, with slips of tissue extending into each toe. The fasciae help the inner and outer longitudinal arches absorb shocks to the foot and bear the stress that is caused by the body’s weight.

Ligaments hold the tendons in place and stabilize the joints. The longest of these, the plantar fascia, originates on the plantar surface of the calcaneus, and attaches to the plantar surfaces of the five metatarsal heads and proximal phalanges of the toes. The plantar fascia is a major stabilizer of the foot, it helps maintain the arch of the foot and is an anti-pronator in that, in its function of maintaining the congruity of the relationship between the calcaneus and the metatarsal heads, it resists the torsion movement of the
forefoot in relationship to the hindfoot in pronation. Most of the eversion of pronation occurs in the mid and forefoot while the calcaneus remains stable in the hindfoot.

**Common terms used to describe the movement of muscles as they relate to joints:**

- **Flexors:** Paired with extensors, flexors bend a joint and bring a limb closer to the body.
- **Extensors:** Paired with flexors, extensors move a limb away from the body.
- **Origin:** the end that is attached to the bone that does not move when the muscle contracts.
- **Insertion:** The other end of the muscle, is attached to a bone that moves when the muscle contracts.
- **Action:** The movement of the body that the muscle produces.
- **Prime mover:** The muscle that acts directly to bring about the desired movement.
- **Antagonist:** The muscle whose action is the direct opposite of that of another muscle.
- **Synergist:** The muscle that contributes to the action of the principle muscle.
- **Fixators:** Accessory muscles that serve to steady a part of the body.

**The main muscles of the foot are:**

- **Anterior Tibialis (AT):** Located at anterior of tibia, in front of ankle joint lateral to medial malleolus and attaches to medial cuneiform and base of first metatarsal bone, the AT is a dorsiflexor which enables the foot to move upward.
- **Posterior Tibialis (PT):** Muscle begins at the top of fibula and tibia on posterior surface and ends in the posterior tibialis tendon that extends below medial malleolus and inserts into the navicular. The PT supports the arch and assists as plantorflexor, and is the prime inverter of the ankle.
- **Peroneus Longus (PL):** Begins at upper part of fibula, continues downwards and behind lateral malleolus, runs diagonally across the plantar surface of foot and attaches to base of first metatarsal and medial cuneiform. Together with the peroneus brevis helps to control movement on the outside of the ankle, and evert the foot as well as plantarflex the ankle joint.
- **Peroneus Brevis:** Begins at distal two-thirds of lateral surface of fibula and leads into peroneus brevis tendon, which runs along lateral surface of calcaneus and attaches to styloid process at the base of the fifth metatarsal shaft. Together with the PL helps control movement on the outside of the ankle, and evert the foot as well as plantarflex the ankle joint.
- **Extensors:** Help the ankle raise the toes to initiate the act of stepping forward.
- **Flexors:** Stabilize the toes against the ground.
Lower extremity Blood Vessels, Nerves, and Skin

Blood Vessels

Arteries: Blood vessels, which transport blood away from the heart
Veins: Blood vessels, which transport blood toward the heart
Capillaries: Small vessel connections between arteries and veins, which provide nutrition to tissues and remove, waste products

The foot’s blood vessels form an extremely fine network of arteries, veins and capillaries to provide the lowest extremity with a rich supply of blood, which carries nutrients to the cells. The dorsalis pedis artery supplies fresh blood to the top of the foot. It is a continuation of the anterior tibial artery, which runs down the thigh and over the front of the leg. To locate the dorsalis pedis artery, place your fingers on the top of the foot over the first metatarsal at the instep – that is, on the top part of the foot in front of the ankle. There should be a definite palpable pulse, similar to the wrist pulse.

The posterior tibial artery supplies blood to the bottom of the foot. It runs down the back of the leg and around the anklebone, where it separates into several smaller branches. You can feel the pulse in this artery behind the anklebone on the inner side of the foot near the midline of the body. Both the dorsalis pedis and the posterior tibial arteries branch out into arterioles, which subdivide into a network of minute arteries, or capillaries.

The veins that return the blood from the foot to the upper portions of the body run directly alongside the arteries. The dorsal and plantar metatarsal veins join with the saphenous vein to return blood to the heart. Other veins of the foot connect with the front and back tibial veins.

Nerves

Nerve: Cordlike fibrous bundles of neurons that transmit sensory and motor impulses between the central nervous system (CNS) and other parts of the body

Like the blood vessels that serve the foot, the nerves follow a definite pattern. There are nerves that serve the bottom of the foot, or stimulate the top; there are deep nerves and nerves for the skin. The main nerves of the foot are continuations of the tibial and peroneal nerves, which stem from the lumbar and sacral regions of the spine and extend the entire length of the leg.

Skin

Skin: The largest organ, the skin covers the entire body as a protective membrane comprised of the dermis and epidermis, which also provides touch sensation to the CNS.
The skin of the foot is of two types, described simply as thick skin and thin skin. The sole of the foot is composed entirely of thick skin, which can be up to five layers deep. (Most areas of the body contain only one layer of skin). Thick skin has no hair follicles or oil glands. When prolonged pressure or friction is applied to thick skin, the outermost layer grows into a leathery, thick mass (a callus). Thick skin on the foot is tough enough to protect the weight bearing bones from injury. The thick skin of the sole also protects the many structures inside the foot against abrasions, lacerations, and perforations by sharp objects. The ridges on the foot’s thick skin, very much liked those that appear in fingerprints, give rise to friction and thus supply a grasping surface for bare foot. Thin skin is the normal epidermis. Thin skin covers the whole foot with the exception of the sole and toenails. Similar to the thin skin on the rest of the body, it consists of only one layer, which contains oil glands and hair follicles.

**Amputations**

Amputation: The surgical removal of part or an entire limb. Foot amputations are often necessary in patients with diabetes. Over 60% of all non-traumatic amputations are in patients who have diabetes. It is important to recognize the areas of the foot most commonly affected by amputation.

Amputation levels within the foot are as follows:

- **Syme:** Amputation of the foot at the ankle joint with removal of both malleoli
- **Pirogoff:** Amputation of the foot at the ankle, part of the calcaneus being left in the lower end of the stump
- **Boyd:** Amputation at the heel of the foot
- **Chopart:** Amputation of the foot, with the calcaneus, talus, and other parts of the tarsus being retained
- **Lis Franc:** A division of the foot between the tarsus and metatarsus; an amputation region
- **Transmetatarsal:** Amputation of the foot at the metatarsal midline
- **Metatarsal disarticulation:** Amputation of the foot at the metatarsal and phalangeal joint
Definitions and Terminology

Descriptive Vernacular

Planes of the body

- Transverse or Horizontal: The plane which divides the body into an upper and lower section, i.e. view from the top; T-toes in, toes out
- Coronal or Frontal: The plane which divides the body into anterior and posterior portions, i.e. view from the front; F-jumping jacks
- Sagittal or Median: The plane that divides the body bilaterally into right and left sections, i.e. view from the side; S-plantar and dorsiflexion

Motions and directions

* RULE: When you want to describe a motion, do not describe the motion at the joint; describe the motion below the joint

- Abduct: Motion of the distal segment away from the midline
- Active movement: Patient moves a part of the body
- Adduct: Motion of the distal segment towards the midline
- Anterior, Ventral: The front part of the body
- Caudal: Situated beneath or on the underside or inferior side of the body; toward the tail
- Cephalad: Toward the head or anterior section of the body
- Cranial: Toward the head
- Deep: Located internal to the surface of the body, e.g. Muscle, Arteries
- Distal: Away from the trunk of the body; further away from the point of insertion
- Dorsal/Dorsum: Top of the foot
- Dorsiflexion: Movement of the foot whereby the foot or toes move upward toward the shin, e.g. Foot off of gas
- Evert: Motion away from the midline
- Extension: Movement of a joint in the body so that the angle between the bones of the limb and at the joint is increased
- Flexion: Bending a joint in the body so that the angle between the bones of the limb and at the joint is decreased
- Inferior: Lower section of the body; below
- Invert: Motion towards the midline
- Lateral: Outside; Away from the midline of the body
- Longitudinal: Lengthwise; parallel to the long axis of the body or a part of the body
- Medial: Inside; toward the midline of the body
• **Origin:** Point of insertion of a muscle
• **Passive movement:** Practitioner moves a part of the patient’s body
• **Pedal:** Related to the foot, e.g. Pedal pulse, Ped, Pod, Pes
• **Plantarflexion:** Movement of the foot whereby the foot or toes move downward toward the sole, e.g. Foot on gas
• **Posterior, Dorsal:** The back part of the body
• **Pronate/pronation:** Tri-planar motion that includes the movements of dorsiflexion + abduction + eversion
• **Proximal:** Closer to the trunk of the body; Closer to the point of insertion
• **Superficial:** Located on or near the surface of the body, e.g. Skin, Vein
• **Superior:** Upper section of the body; above
• **Supinate:** Tri-planar motion that includes the movements of plantarflexion + adduction + inversion
• **Transverse:** Placed crosswise, situated at right angles to the long axis of the body or of a part
• **Valgus:** Fixed, eversion away from the midline
• **Varus:** Fixed, inversion towards the midline

**Medical Word Parts**

• **a-:** Without, not, lack of, e.g. ataxic muscular coordination
• **-algia:** Refers to pain, e.g. metatarsalgia
• **amphi-:** On both sides, e.g. amphiarthrosis
• **ab-:** From, away from, e.g. abduction
• **ad-:** To, toward, near, e.g. adduction
• **-ad:** To, toward, near, e.g. cephalad
• **ambi-:** Both, both sides, e.g. ambidextrous
• **ankyl/o:** Stiff joint, e.g. ankylosis
• **anter/o:** Before, in front of, e.g. anterolateral
• **anti-:** Against, antifungal
• **arthr/o:** Refers to a joint, e.g. diarthrosis
• **bi-:** Two, e.g. bilateral
• **chronand/o:** Cartilage, e.g. chondromalacia
• **circum-:** Around, e.g. circumduct
• **cutane/o:** Skin, e.g. subcutaneous
• **dactyl/o:** Refers to a finger or toe digit, e.g. syndactyly
• **derm/a:** Refers to the skin, e.g. dermatology
• **-desis:** To bind or stabilize, e.g. arthrodesis
• **dors/o:** The back or top of the foot, e.g. dorsolateral
• **dys-:** refers to a bad, painful, or difficult condition, e.g. dysfunction
• **endo-:** Refers to an inner location, within something, e.g. endoscopy
• **epi-:** Upon or surrounding, e.g. epidermis
• **eryth:** Red in color, e.g. erythematous, erythrocyte
• **-esthesia:** Denotes feeling or sensation, e.g. anesthesia
- **-o/genesis**: Refers to a beginning or formation, e.g. erythrogenesis
- **hem/o**: Refers to blood, e.g. hemoglobin
- **hemi-**: Half or partial, e.g. hemidysesthesia
- **hidr/o**: Refers to sweat, e.g. hyperhidrosis
- **homo-**: Same, e.g. homolateral
- **hydr/o**: Refers to water, e.g. anhydrosis
- **hyper-**: Over, above, or excessive, e.g. hyperextend
- **hypo-**: Under, below, or beneath, e.g. hypoglycemic
- **infra-**: Below, beneath, inferior, e.g. infrapatellar
- **inter-**: Located between, e.g. interosseous
- **intra-**: Located in, within, e.g. intra-articular
- **-itis**: Refers to inflammation, e.g. sesamoiditis
- **kerat/o**: Horn-like substance, e.g. keratosis
- **kines/o - kinesis**: Refers to Movement, e.g. kinesiology, hyperkinesis
- **macro**: Large, e.g. macromelia
- **mal-**: Bad or poor, e.g. malalignment
- **medi-**: Located in the middle of, e.g. medial
- **meta-**: Located after, beyond, or behind, e.g. metatarsal
- **my/o**: Refers to muscle tissue, e.g. myofascitis
- **myc/o**: Refers to fungus or fungal, e.g. mycodermatitis
- **myel/o**: Refers to either the bone marrow or the spinal cord, e.g. poliomyelitis, myeloma
- **neur/o**: Refers to a nerve, e.g. neuron neuralgia
- **onych/o**: A finger or toe nail, e.g. onychogryphosis curvature
- **orth/o**: Straight, upright, or correction, e.g. orthograde walk
- **oste/o**: Bone, e.g. osteomyelitis
- **-parexis**: A slight paralysis, or loss of sensation, e.g. hemiparesis
- **-plegia**: Complete paralysis, e.g. quadriplegia
- **ped-, pod-**: Refers to the foot, e.g. pedorthics, podiatric
- **phleb/o**: Refers to a vein, e.g. phlebitis
- **-pathy**: Disease, e.g. neuropathy
- **pre-**: Before or in front of, e.g. prematurity
- **primi-**: First, e.g. primivarus
- **pseudo-**: False, e.g. pseudopodia
- **-pyorrhea**: Discharge of pus, e.g. dermopyorrhea
- **retro-**: After or located behind, e.g. retrocalcaneal
- **semi-**: Half or partial, e.g. semipermeable
- **sub-**: Under, beneath, or below, e.g. subluxation
- **supra-**: Above, e.g. supraorbital ridge
- **sym-**: In union with, together, e.g. symphysis pubis
- **uni-**: One, e.g. unilateral
- **ven/o**: Vein, e.g. venopuncture
Terminology

- Abduct: Motion of the distal segment away from the midline
- Abduction: Movement of a body part away from the median plane of the body
- Achilles tendon: Largest tendon in the back of the leg, joining the heel
- Active movement: Patient moves a part of the body
- Adduct: Motion of the distal segment towards the midline
- Adduction: Movement of a body part toward the median part of the body
- Ambulate, Ambulation: Walking about
- Amphiarthrosis: A form of articulation permitting little motion (e.g.: pubic symphysis)
- Ankle Joint: Also known as the talocrural joint (TCJ), this is the joint which connects the proximal end of the talus to the malleoli of the tibia and fibula, forming the “hinged” ankle joint
- Antagonist: A muscle whose action is the direct opposite of that of another
- Anterior, Ventral: The front part of the body
- Anterolateral: Away from midsagittal
- Arteries: Blood vessels which transport blood away from the heart
- Arthritis, Rheumatoid: State characterized by inflammation of joint or joints
- Articular cartilage: Cartilage found at the joints
- Balance: Equalization or opposing forces
- Ball: Width of the sole at the metatarsal heads
- Bilateral: Pertaining to right and left sides
- Biomechanics: The science of locomotion of the human body
- Blucher: Front-laced shoe in which the quarters are not attached distally to the Vamp, giving more allowance at the throat and instep in fitting
- Boyd: Amputation at the heel of the foot
- Breathability: The ability to allow air exchange to the foot through the material of the shoe
- Bunion: Also known as hallux valgus, a bunion is an inflammatory swelling of the bursa over the metatarsophalangeal joint of the great toe.
- Calcaneus: The largest of the tarsal bones; it forms the heel and articulates with the cuboid anteriorly and the talus above
- Cancellous or Spongy Bone: Soft bone texture primarily present in the heads of bone and near the marrow cavity
- Capillaries: Small vessel connections between arteries and veins which provide nutrition to tissues and remove waste products
- Caudal: Situated beneath or on the underside or inferior side of the body; toward the tail
- Cavus (Pes Cavus): Hollow foot, an exaggeration of the normal arch
- Cephalad: Toward the head or anterior section of the body
- Chopart: Amputation of the foot, with the calcaneus, talus, and other parts of the tarsus being retained
• **Chukka**: Three-quarter blucher boot with two or three eyelets or velcro closure
• **Compact or Dense Bone**: Highly vascularized bone tissue found in the diaphysis of the bone
• **Composition**: Various materials, which are pulverized, compressed and held with a binder to form a sheet material for insoles, midsoles and heel bases, and other components
• **Conform**: Ability of a material to be molded to the shape of the foot
• **Cookie**: Longitudinal arch pad
• **Counter**: Long counter extended distally; lateral counter is extended to the fifth metatarsal region; medial counter is extended to the first metatarsal region
• **Cranial**: Toward the head
• **Cuboid**: On lateral side of foot, articulates proximally with calcaneus and distally with bases of fourth and fifth metatarsal shafts
• **Cuneiforms**: Three wedge-shaped bones located between distal aspect of navicular and bases of three medial metatarsal shafts
• **Custom molded shoe**: Shoe molded from a full-dimensional cast of a patient’s foot
• **Deep**: Located internal to the surface of the body, e.g. muscle, arteries
• **Diaphysis**: The elongated cylindrical portion (the shaft) of a long bone, between the ends or extremities, which are usually articular and wider than the shaft
• **Diarthrosis**: A movable joint (e.g.: synovial joints)
• **Distal**: Some part of the body that lies away from the central portion, or trunk, of the body
• **Dorsal/Dorsum**: Top of the foot
• **Dorsiflexion**: Movement of the foot whereby the foot or toes move upward toward the shin, e.g. Foot off of gas
• **Dorsum**: Top aspect of the foot
• **Edema**: Accumulation of fluid in the tissues
• **Elevation**: Material added to the plantar aspect of the shoe for limb-length discrepancies
• **Epiphysis**: The end of a long bone, usually wider than the shaft, and either entirely cartilaginous or separated from the shaft by a cartilaginous disk
• **Eversion**: Turning away from the midline of the body
• **Evert**: Motion away from the midline
• **Extension**: Movement of a joint in the body so that the angle between the bones of the limb and at the joint is increased
• **Extensor Digitorum Longus**: Runs along anterior surface of tibia along dorsal aspect of foot and extends to four toes; function is to extend toes and dorsiflex the ankle
• **Extensor Hallucis Longus**: Runs along anterior surface of fibula and crosses anterior to the ankle joint into dorsal surface of distal phalanx of hallux; function is to dorsiflex the hallux and ankle joint
• **Extensor**: Muscle that straightens a joint and moves a limb farther from the body
• **Extrinsic muscle**: A muscle which originates outside of the part of the body where it is found or upon which it acts
• **Fascia**: Tough fibrous membrane which covers muscles and other soft structures of the body, and can serve to join bones or separate muscle
• **Fibula**: Located on lateral aspect of leg and is a more slender bone – distal end is the lateral malleolus, part of the ankle joint
• **Fixator**: An accessory muscle that serves to steady a part
• **Flange**: A projected edge
• **Flare**: Widened heel or sole base
• **Flexion**: Bending a joint in the body so that the angle between the bones of the limb and at the joint is decreased
• **Flexor Digitorum Longus**: Located at the middle of the posterior tibial surface, leads to tendon that runs behind medial malleolus along plantar surface of foot and inserts into distal phalange of lesser toes; function is gripping of the lesser toes, and assist in plantarflexion of the ankle joint
• **Flexor Hallucis Longus**: Location begins at lower two-thirds of posterior surface of fibula and runs along plantar of surface foot inserting into base of hallux; function is to flex the hallux and assist in plantarflexion of the ankle joint
• **Flexor**: A muscle that bends a joint and brings a limb closer to the body
• **Functional shoe**: Shoe designed to change the biomechanics of a person’s gait
• **Gastrocnemius**: Has two heads, medial, and lateral, and runs along posterior surface of calf into the achilles tendon; function is to assist the soleus in flexing the ankle joint
• **Geriatric**: Older people in the physiologic and pathologic aspects
• **Girth**: Circumferential dimension measured around the last
• **Hallux rigidus**: The great toe, a condition in which walking is painful
• **Hallux valgus**: A deviation of the great toe toward the outer or lateral side of the foot
• **Hallux**: Great or big toe
• **Hammer toe**: A hammertoe is a toe hyperextended at the distal interphalangeal and metatarso-phalangeal joints. The proximal interphalangeal joint is acute flexed
• **Heel elevation**: Material added to the heel only to accommodate equines position or leg length discrepancy
• **Heel, Thomas**: Heel with anteriorly extended medial border
• **Hindfoot**: The tarsus region or back part of the foot
• **Inferior**: Lower section of the body; below
• **Inflare**: Last or shoe whose distal region provides more medial than lateral surface area
• **Inlay**: Material or device inserted into the shoe
• **Inner sole**: Material conforming to the size and shape of the last bottom upon which the foot rests; an insole
• **Insensitive**: Not appreciable by the senses; insensate
• **Insertion**: The end of the muscle that is attached to a bone or ligament that moves upon muscle contraction
• **Instep**: Portion of the upper over the midfoot
• **Internal**: Inner part of a structure, e.g. the inside of a shoe
• **Inversion**: A motion in which the foot is rotated or turned inwardly
• **Invert**: Motion towards the midline
• **Joint capsule**: A structure in which the diarthrotic or synovial joint is encased. Composed of fibrous and synovial membranes, the joint capsule attaches the ends of the articulations together
• **Joint cavity**: The enclosed, fluid-filled space inside the joint capsule that allows the two bones of the joint to move against each other with little or no friction, due to the presence of synovial fluid within the cavity
• **Last**: Model approximating the shape and size of the foot, over which a shoe is made; usually made of wood or plastic, or plaster
• **Lateral**: Pertaining to the side or outside; away from the midline or median of the body
• **Levy mold**: Full-length inlay that conforms to contour of the plantar foot
• **Ligament**: A band or sheet of tough, fibrous connective tissue which attaches two or more bones, cartilages, or other structures as well as providing support for fasciae or muscles
• **Lis Franc**: A division of the foot between the tarsus and metatarsus; an amputation region
• **Longitudinal**: Lengthwise; parallel to the long axis of the body or a part of the body
• **Longitudinal arch**: Arc of hindfoot and midfoot from mid-calcaneus extending proximal to the first metatarsal head
• **Malleolus/i**: Malleolus means hammer in Latin, and is used to describe the bony projection found at the distal end of the fibula and the tibia, that forms the ankle joint in combination with the talus
• **Medial**: Pertaining to the middle; toward the midline of the body
• **Medullary cavity**: Pertaining to the marrow of the bone
• **Metatarsal bar**: Rubber, leather, or synthetic bar applied transversely to the sole of the shoe with the apex immediately behind the metatarsal heads
• **Metatarsal disarticulation**: Amputation of the foot at the metatarsal and phalangeal joint
• **Metatarsal pad**: A device placed proximal to the metatarsal heads to relieve pressure and redistribute weight
• **Metatarsal**: Relating to the metatarsus or to one of the metatarsal bones
• **Midsole**: Sole placed between inner and outer sole
• **Midtarsal joint**: A combination joint comprised of the calcaneocuboid joint located on the lateral side of the foot, and the talonavicular joint located on the medial side of the foot
• **Morton’s Syndrome** (Morton, Dudley J., Anatomist): In the congenitally short first Metatarsal bone; changes the weight bearing pattern of the foot by Taking pressure off the second metatarsal (generally resulting in pain)
• **Muscle (Skeletal):** A tough, elastic tissue that is attached at either end to a fixed location and moves or stabilizes a body part via contraction

• **Muscle action:** The movement of the body produced by the muscle

• **Navicular:** Boat shaped bone (proximal portion is concave and distal portion is convex) that articulates with head of talus proximally and cuneiforms distally; function is to transmit forces from the hindfoot to the forefoot

• **Nerve:** Cordlike fibrous bundles of neurons that transmit sensory and motor impulses between the central nervous system (CNS) and other parts of the body

• **Origin:** The initial point of attachment of a muscle; the origin does not move when the muscle contracts

• **Orthoses:** Supportive device for the body

• **Outflare:** Last or shoe whose distal region provides more lateral than medial surface area

• **Oxford:** Low-quarter, laced shoe

• **Passive movement:** Practitioner moves a part of the patient’s body

• **Pedal:** Related to the foot, e.g. pedal pulse, ped, pod, pes

• **Pedorthics:** Allied foot health profession concerned with the design, manufacture, fit, and modification of footwear and related appliances

• **Periosteum:** A specialized connective tissue covering all bones of the body, and possessing bone-forming potentialities

• **Peroneus Brevis (PB):** Begins at distal two-thirds of lateral surface of fibula and leads into peroneus brevis tendon, which runs along lateral surface of calcaneus and attaches to styloid process at base fifth metatarsal shaft; function is evert the foot and assist the PL in ankle plantarflexion

• **Peroneus Longus (PL):** Muscle that Begins at upper part of fibula, continues downwards and behind lateral malleolus, runs diagonally across plantar surface of foot and attaches to base of first metatarsal and medial cuneiform; function is to evert the foot and to plantarflex the ankle joint

• **Pirogoff:** Amputation of the foot at the ankle, part of the calcaneus being left in the lower end of the stump

• **Plantar fasciitis:** Non-specific inflammatory change in the plantar fascia, resulting in pain beneath the heel

• **Plantar:** Bottom aspect of the foot

• **Plantarflexion:** Movement of the foot whereby the foot or toes move downward toward the sole, e.g. Foot on gas

• **Planus, pes planus:** Refers to the presence of a flat foot

• **Platform:** Elevated sole

• **Posterior, dorsal:** The back part of the body

• **Posterior:** Back, as in the back portion of the shoe or foot

• **Prime mover:** The muscle that acts directly to bring about the desired movement

• **Pronate/pronation:** Tri-planar motion that includes the movements of dorsiflexion + abduction + eversion

• **Pronation:** Tri-plane motion of the foot consisting of eversion, dorsiflexion, and abduction
• **Proximal:** Closer to the trunk of the body; Closer to the point of insertion
• **Ray:** The metatarsals and phalanges combined form a ray, i.e., the first ray is the first metatarsal and the hallux (big toe)
• **Rocker bar:** Sole bar with the apex beneath the metatarsal shafts, causing rocking instead of flexing action
• **Rocker bottom:** A modified sole apexed at various positions to assist the gait cycle and relieve or transfer pressure from the designated areas of the foot
• **Shank:** Firm, stiff, inflexible area of the shoe between the heel breast and ball
• **Short bones:** Small bones that are generally cuboidal in structure, found primarily in the hands and feet
• **Skin:** The largest organ, the skin covers the entire body as a protective membrane comprised of the dermis and epidermis, which also provides touch sensation to the CNS
• **Soleus:** Located at posterior surface of fibula shaft and leads to Achilles tendon; function is to assist the gastrocnemius in flexing the ankle joint
• **Spur:** A dull spine or projection from a bone; a small projection from any structure
• **Subtalar joint (STJ):** The joint which joins the calcaneus to the talus, and enables the foot to rotate at the ankle
• **Sulcus:** Long, narrow groove or furrow on the plantar surface of the foot proximal to the phalanges
• **Superficial:** Located on or near the surface of the body, e.g. Skin, Vein
• **Superior:** Upper section of the body; above
• **Supinate/supination:** A tri-plane motion consisting of the simultaneous movement of the calcaneus and the foot in the direction of adduction, inversion, and plantarflexion
• **Sustentaculum tali:** Projection on medial side of heel that helps support the talus of calcaneus
• **Syme:** Amputation of the foot at the ankle joint with removal of both malleoli
• **Synarthrosis:** An immovable articulation in which the bony elements are united by continuous intervening fibrous tissue (e.g.: joints between the teeth and jaw bones)
• **Synergist:** A muscle that contributes to the action of the principle muscle
• **Talocrural joint (TCJ):** The joint which connects the proximal end of the talus to the malleoli of the tibia and fibula, forming the “hinged” ankle joint
• **Talus:** Key bone of the foot in contact with tibia and fibula, calcaneus and navicular; movements of hindfoot and midfoot are tied to this bone
• **Tarsus:** The seven bones that form the hind portion of the foot
• **Tendon:** A tough flexible connective tissue that attaches muscle to the periosteum of the bones
• **Thermoplastic:** Synthetic material that can be repeatedly softened by heat and hardened by cooling
• **Tibia:** Located medially, is larger of two bones of the leg – distal end is the medial malleolus, which forms parts of the ankle joint
• **Tibialis Anterior**: Located at anterior of tibia, in front of ankle joint lateral to medial malleolus and attaches to medial cuneiform and base of first metatarsal bone; function is to dorsiflex ankle

• **Tibialis Posterior (TP)**: Location begins from top of fibula and tibia on posterior surface, ending in posterior tibialis tendon that extends below medial malleolus and inserts into the navicular; function is to invert the foot and assist in plantarflexion of the ankle joint

• **Toe box**: Reinforcement used to retain the original contour of the toe and guard the foot against trauma or abrasion

• **Toe crest**: Convex cushion under the plantar phalangeal-sulcus

• **Transmetatarsal**: Amputation of the foot at the metatarsal midline

• **Transverse arch**: The arch formed by the metatarsal bones, 1-5

• **Transverse**: Placed crosswise, situated at right angles to the long axis of the body or of a part

• **Ulcer, Trophic**: A lesion on the surface of the skin or a mucous surface caused by superficial disintegration and loss of wound with superficial loss of tissue from trauma is not primarily an ulcer, but may turn into one if healing stops or infection occurs

• **Valgus**: Angular deformity in which the limb distal to the deformity is angulated away from the midline; fixed, eversion away from the midline

• **Vamp**: Forepart of the shoe upper over the metatarsal shafts

• **Varus**: Angular deformity in which the limb distal to the deformity is moved closer to the midline of the body; fixed, inversion towards the midline

• **Veins**: Blood vessels which transport blood toward the heart

• **Wedge**: Tapered leather, rubber, or other material used to elevate one side of the sole and/or heel; also known as heel wedge