

ANATOMY TERMINOLOGY

I. Anatomy - *anatome*: *ana* = up; *tome* = cutting

A. Study of anatomy can be subdivided according to the size of the parts studied.

1. Microscopic anatomy, or histology - uses the microscope to magnify tissues and cells of the body
2. Macroscopic anatomy, or gross anatomy - uses the unaided eye to study tissues and organs of the body

B. Histology is studied systemically, i.e. by organ system (i.e. digestive system, nervous system)

C. Gross anatomy is generally studied regionally, because that is the way dissections are most effectively conducted (it can also be viewed and discussed systemically to understand organ function)

1. Upper extremity region
2. Back region
3. Head and neck region
4. Thorax region
5. Abdomen region
6. Pelvis and perineum region
7. Lower extremity region

II. Anatomical Terminology

A. Basis for terminology

1. Generally, terms will be informative or descriptive
2. Although only one term is official (*Terminologia Anatomica*), often there is more than one term for a structure
3. Avoid the use of eponyms - names of persons i.e.
 - Poupart's ligament = inguinal ligament
 - Cooper's ligaments = suspensory ligaments of breast
 - Hunter's canal = adductor canal

B. Terms of position and direction

1. Anatomical position - body erect; head, eyes, toes directed forward; upper limbs at the side of the body, with palms directed forward
2. Planes - imaginary sections through the body in various directions
 - a] median - vertically directed plane from front to back, through the sternum and vertebral spines; it splits the body into right and left halves
 - b] frontal, or coronal - vertical planes which intersect the median plane at right angles; they divide the body into front and back parts

- c] horizontal, or transverse - planes passing through the body at right angles to both the median and coronal planes; they divide the body into upper and lower portions
- d] sagittal - vertical planes passing through the body parallel to the median plane, but not passing through the midline; they divide the body into right and left portions

3. Direction

- a] medial - nearer or towards the median plane
- b] lateral - further from the median plane
- c] anterior or ventral - nearer to the front of the body
- d] posterior or dorsal - nearer to the back of the body
- e] superior or cephalic - nearer to the top of the head
- f] inferior or caudal - nearer to the bottom of the feet
- g] superficial - towards the surface of an organ or the body
- h] deep - towards the center of an organ or the body
- i] proximal - nearer the point of origin or attachment
- j] distal - further from the point of origin or attachment

III. Skeleton

A. Bone - A specialized connective tissue made rigid by the addition of inorganic salts

1. Functions

- a] protection - skull and vertebral column protect the brain and spinal cord; ribs protect thoracic and upper abdominal organs
- b] support - provides support and erect posture
- c] movement - provides attachment for muscles; allows erect posture
- d] storage site for calcium (Ca^{++})
- e] houses blood forming cells

2. Types of bones

- a] long bones - bones whose lengths are greater than their breadths; found in the extremities
 - 1] diaphysis - shaft
 - 2] metaphysis - part of diaphysis nearest 2° ossification center
 - 3] epiphysis - secondary ossification center at the ends of bone
- b] short bones - roughly cuboidal in shape with < four surfaces for articulation; the carpal bones of the hand and tarsal bones of the foot
- c] flat bones - bone is mostly flat; calvaria of the skull, sternum, scapula
- d] irregular bones - inominate bones, facial bones, vertebrae
- e] sesamoid - bones which develop within a tendon; patella, pisiform, fabella

3. Named markings

- a] lines, ridges, or crests
- b] rounded elevations
 - 1] tuberosity; trochanter - large, rounded
 - 2] tubercle - small
 - 3] protuberance - swelling
 - 4] malleolus - mallet-like
- c] spines or processes - sharp elevations

- d] fossae, notches, grooves - depressions along bones
- e] foramina - holes in bones
- f] canals - tunnels in bones
- g] meatuses - canals which do not go clear through a bone
- h] heads; condyles - articular ends of bone
- i] epicondyles - elevations just proximal to condyles

B. Joints - connections in the skeleton between any of its rigid component parts - bones or cartilage

1. Fibrous - a joint united by fibrous connective tissue
 - a] sutures - bones of the skull; allows little or no movement
 - 1] serrate - interlocking edges
 - 2] squamous - overlapping edges
 - 3] synostosis = complete fusion of the bones across suture lines
 - b] syndesmosis - apposed bones joined together by abundant fibrous tissue
 - 1] inferior tibiofibular joint
 - 2] tympanostapedial joint of middle ear
 - 3] interosseous membrane
 - radioulnar
 - tibiofibular (middle)
 - c] gomphoses - between teeth and bony sockets
2. Cartilaginous - bones with intervening cartilage connecting them, either hyaline or fibrous cartilage
 - a] 1° cartilaginous (synchondroses)
 - 1] epiphyseal plate in growing bones
 - 2] cartilaginous union between the sternum and the first rib
 - 3] synostosis = the conversion of a cartilaginous joint to bone
 - b] 2° cartilaginous (symphyses) - skeletal elements' surfaces are covered by hyaline cartilage and joined by fibrous cartilage
 - 1] intervertebral discs
 - 2] pubic symphysis
3. Synovial - the most common type of joint, it has four characteristics:
 - a joint cavity
 - joint surfaces lined with articular cartilage
 - joint cavity lined by synovial membrane
 - joint space is covered by an articular capsule
 - a] plane (gliding or sliding) - capable of movement in any direction, but generally within a single plane (uniaxial); joint surfaces are almost flat
 - 1] articular joints of the vertebrae
 - 2] carpal, tarsal, carpometacarpal (except 1st), tarsometatarsal joints
 - 3] acromioclavicular joint
 - b] hinge - permit movement in only one plane (two directions), flexion and extension
 - 1] elbow (humeroulnar) joint
 - 2] interphalangeal joints

- c] condyloid - similar to hinge joints, but ellipsoidal shaped joint surfaces permit more movement, generally in two planes, at right angles to each other (biaxial)
 - 1] knee joint
 - 2] wrist (radiocarpal) joint
 - 3] metacarpophalangeal joints
- d] pivot - permit movement in only one direction, but around a longitudinal axis related to the bone
 - 1] radioulnar joint
 - 2] atlantoaxial joint
- e] saddle - articular surfaces are concavoconvex in shape and movements are in two planes (biaxial)
 - 1] first carpometacarpal joint (of the thumb)
 - 2] sternoclavicular joint
- f] ball and socket - one bone has a rounded convex head and the other has a concave socket; it permits movement in any direction; the freest of the synovial joints
 - 1] hip
 - 2] shoulder

C. Structures associated with synovial joints

1. Ligaments - Bands or sheets of fibrous connective tissue connecting two structures, generally bones.
 - a] intrinsic - intra-articular; within a joint cavity
 - b] capsular - thickenings of the joint capsule
 - c] extrinsic - extracapsular; connective tissue bands outside the joint capsule to provide joint stability
2. joint cartilages - additions to synovial joints
 - a] articular discs - fibrous cartilage pads which subdivide a joint cavity; they provide added cushion to the joint action
 - b] meniscus and labrum - rims of fibrous cartilage, for molding or increasing the size of the joint surface

D. Cartilage - Specialized rigid connective tissue. In the skeleton cartilage serves as:

1. Growth plate for bones, especially the long bones
2. A bridge between adjacent bones
3. Sliding surface and shock absorbers for joints

IV. Skeletal Muscles

A. Morphology - the architecture of a muscle will determine its strength and excursion. The strength of a muscle is directly proportional to its cross sectional area.

1. Parallel, or nearly parallel (fan shaped) - muscle fibers run parallel or nearly parallel to each other and to the length of the muscle; this gives the greatest degree of movement
2. Pennate - literally means feather-like; it means that the tendon runs nearly the length of the muscle and the fibers insert into the tendon at an angle

- a] unipennate - fibers insert at an angle along one side of the tendon
- b] bipennate - fibers insert at angles along two sides of the tendon
- c] multipennate - the tendon has many septa into which fibers insert
- d] circumpennate - the tendon runs through the center of the muscle and receives fibers all around the tendon

B. Muscle names - muscles are named for the following:

- a] shape or geometry
- b] action
- c] attachment(s)
- d] location

C. Muscle movement

1. Role in motion - one muscle may have more than one role, depending on the motion
 - a] prime mover - a single (generally) muscle which is mostly responsible for a particular action
 - b] antagonist - a muscle which produces the opposite action
 - c] synergist - a muscle which assists the prime mover; it assists in the desired movement or prevents undesired movement
 - d] fixator - a muscle which stabilizes a joint so other muscles can act more efficiently
2. Types of movement
 - a] flexion - to narrow (reduce) the angle of a joint (in the foot, it is also called plantar flexion)
 - b] extension - to increase the angle of a joint (in the foot, it is also called dorsiflexion)
 - c] abduction (take away) - movement away from the midline (or midpoint of the hand/foot)
 - d] adduction (add to)- movement toward the midline (or midpoint of the hand/foot)
 - e] pronation - rotating the forearm so the dorsum of the hand faces anteriorly
 - f] supination - rotating the forearm so the palm of the hand faces anteriorly
 - g] circumduction - circular motion of the shoulder or the hip; involves flexion, extension, abduction, adduction, rotation
 - h] protraction - moving anteriorly, as in protracting the scapula
 - i] retraction - moving dorsally, as in retracting the scapula
 - j] opposition - drawing of the thenar pad toward contact with the hypothenar pad (reposition is to return thumb to anatomical position)
 - k] elevation - to raise superiorly
 - l] depression - to move inferiorly
 - m] lateral bending - to move the trunk of the body away from the median plane
 - n] rotation - to move the body or extremity around a longitudinal axis
 - 1] lateral - to rotate a joint externally, away from the median plane
 - 2] medial - to rotate a joint internally, toward the median plane
 - o] inversion (also called supination) - to rotate the medial border of the foot superiorly
 - p] eversion (also called pronation) - to rotate the lateral border of the foot superiorly
 - q] hyperextension - to extend beyond normal range

V. Central Nervous System - A collection of neurons and fiber tracts which collects, interprets, relays and initiates response activity. It consists of the Brain and Spinal Cord

VI. Peripheral Nervous System - conduits for information to and from tissues and organs of the body and the central nervous system; may be sensory (afferent), motor (efferent), or both

A. Cranial nerves - twelve pairs of nerves supplying structures of the head and neck and their derivatives

B. Spinal nerves - 31 pairs of nerves supplying those areas not supplied by cranial nerves

1. Typical spinal nerve - consists of mixed sensory and motor nerve fiber components

a] dorsal root(lets) - sensory fibers from a spinal nerve to the dorsal horn of the spinal cord

b] ventral root(lets) - motor fibers from the ventral horn of the spinal cord to a spinal nerve

c] dorsal primary rami - mixed sensory and motor branches of spinal nerves which supply the deep back muscles and the skin overlying the deep back muscles (a narrow band of skin on either side of the median plane)

1] medial cutaneous branches (in gross anatomy, cutaneous = sensory [plus sympathetics])

2] lateral cutaneous branches

d] ventral primary rami - mixed sensory and motor branches of spinal nerves which supply the rest of the trunk wall and the four extremities

1] lateral cutaneous branches

- anterior branches

- posterior branches

2] anterior cutaneous branches

- medial branches

- lateral branches

2. Plexus - intermingling of nerve fibers from different areas or spinal levels

a] spinal nerve - a plexus of ventral primary rami from different levels

1] cervical - C1-C4

2] brachial - C5-T1

3] lumbar - L1-L4

4] sacral - L4-S4

- Remember: there may be variation in contributions to spinal plexuses.

b] autonomic - mixing of autonomic nerve fibers from different areas

1] sympathetic

2] parasympathetic

C. Ganglia - collections of neuron cell bodies outside the Central Nervous System (CNS)

1. dorsal root - contain sensory neuron cell bodies, but no synapses; a synapse is defined as the transfer of a nerve impulse from one neuron to another, or from a neuron to an effector organ

2. autonomic - contain postganglionic neuron cell bodies, do have synapses with preganglionic neuron fibers

D. Autonomic nervous system - automatic nervous system

1. Characteristics
 - a] regulates all visceral structures
 - b] is automatic - involuntary
 - c] is, by definition, motor, or efferent - even though it is now known that the autonomic nerves carry afferent (sensory) fibers - accounts for visceral pain
 - d] consists of two neurons (is two neurons long)
 - 1] preganglionic - located within the CNS
 - 2] postganglionic - located in autonomic ganglia
 - e] consists of two antagonistic parts which generally innervate the same visceral organs
 - 1] sympathetic
 - 2] parasympathetic

2. Sympathetic nervous system - found in all 31 pairs of spinal nerves, but outflow from the CNS is T1-L2
 - a] thoracolumbar - outflow from all 12 pairs of thoracic and lumbar spinal nerves 1 and 2
 - b] preganglionic neurons - cell bodies located in the spinal cord between the dorsal horn and the ventral horn; fibers enter spinal nerves with the ventral roots
 - c] rami communicans - means of sympathetic fibers leaving or re-entering spinal nerves
 - 1] white - conducts preganglionic fibers out of spinal nerves and into the sympathetic chain
 - 2] gray - conducts postganglionic nerve fibers back into spinal nerves
 - d] ganglia - contain cell bodies of postganglionic neurons (2nd neuron)
 - 1] sympathetic chain (paravertebral) - run on either side of the vertebral column
 - 2] collateral (prevertebral) - some distance from the origins of their preganglionic fibers; generally around blood vessels; they receive splanchnic nerves
 - e] splanchnic nerves - preganglionic nerve fibers which leave the sympathetic chain without synapsing; they synapse in collateral ganglia
 - f] postganglionic nerve fibers - from autonomic ganglia, after synapse; travel to the effector organ
 - g] preganglionic fibers are relatively short - postganglionic fibers are relatively long
 - h] functions - generally prepares body for "fight or flight"
 - 1] increases: heart rate, blood pressure, blood flow to somatic muscles, respiration
 - 2] decreases: peristalsis, blood supply to the viscera
 - 3] dilates pupils
 - 4] stimulates sweat glands
 - 5] stimulus is generalized and long-lasting - one preganglionic neuron activates up to 20 postganglionic neurons

3. Parasympathetic nervous system
 - a] craniosacral - outflow is via cranial nerves and sacral spinal cord
 - 1] cranial nerves numbered 3, 7, 9 and 10
 - 2] sacral spinal nerves S2-S4

- b] preganglionic neurons - cell bodies are located in special ganglia in the brain stem and in the sacral spinal cord
- c] ganglia - contain the cell bodies of postganglionic neurons
 - 1] special - four in number, synapsing with preganglionic fibers from cranial nerves 3, 7 and 9, but all hang off of CN #5
 - 2] intrinsic - in the walls of the organs innervated, associated with cranial nerve 10 and S2-S4
- d] postganglionic nerve fibers - from the 2nd neuron cell bodies after synapse, they innervate effector organs
- e] preganglionic fibers are long and postganglionic fibers are very short
- f] functions - to preserve the body as a vegetative organ
 - 1] decreases heart rate
 - 2] increases peristalsis
 - 3] constricts pupil and accommodates the eye
 - 4] empties the bladder and rectum
 - 5] stimulates salivary and lacrimal glands
 - 6] stimulus is discrete, localized and short-lived; one preganglionic neuron will effect as few as two postganglionic neurons

VII. Blood Vessels

- A. Arteries - blood vessels which carry blood away from the heart
 - 1. Elastic arteries - the largest of the arteries, these contain abundant elastic fibers in their walls; their function is to stretch with the pressure of cardiac systole
 - 2. Muscular arteries - these are the distribution vessels; their walls consist predominantly of circular smooth muscle
 - 3. Arterioles - the smallest of the arteries, they function to control blood pressure; they distribute and control blood flow to the capillary beds
- B. Capillaries - the exchange vessels of the circulatory system, they consist of endothelium and a basal lamina
- C. Veins
 - a] conduct blood back to the heart
 - b] they begin as venules and drain into increasingly larger-sized vessels
 - c] they form anastomotic networks
 - d] they are more numerous than arteries
 - e] they tend to be paired or in multiples
 - f] paired veins accompanying an artery in the extremities are termed venae comitantes
 - g] approximately eighty percent of blood at any one time is in veins
 - h] veins of the extremities contain valves, which allow flow of blood in only one direction
- D. Lymphatics - vessels which conduct tissue fluid back into the blood vascular system
 - 1. Lymph vessels - extremely thin-walled channels from the tissues, they collect in increasingly larger vessels, the largest of which are termed lymphatic ducts; they contain numerous valves and are afferent only, conducting lymph toward the heart
 - 2. Lymph nodes - collections of lymphocyte producing tissues situated along lymph vessels at strategic sites; they filter lymph and dump lymphocytes into it to fight infection