Functional Evaluation

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Objectives

- Learn anatomy of movement
- Learn basic physiology of movement
- Learn basic testing principles to determine appropriate, individual course of action for the client

Anatomy

Introduction:
Structures and Movement

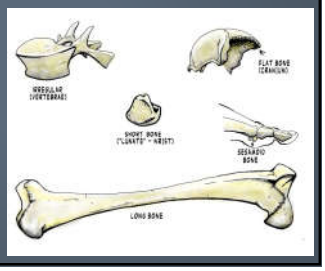
Structures

- Bones
- Joints
- Fascia
- Muscles
- Nerves
- Blood vessels

Bones

The human body contains 206 bones

5 different types of bones
- Long
- Short
- Flat
- Sesamoid
- Irregular



Anatomical Landmarks of Bone

Tuberosity: Large bump on the bone

Tubercle: Smaller bump on the bone

Process: Projection from the bone

All 3 of these prominences usually serve as an attachment for soft tissue structures

Spine or Spinous process: Typically a longer and thinner projection of bone, unlike any of the other prominences

Anatomical Landmarks Cont.

Condyle: Rounded surfaces at either end of a long bone.

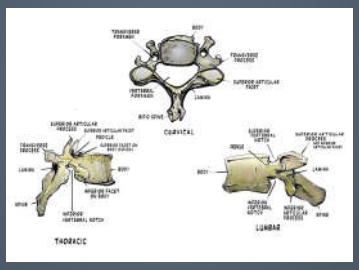
Epicondyles: Small bony knobs that sometimes appear just above the condyles of a bone.

Fossa: A smooth, hollow surface on a bone, usually functions as a source of attachment for other structures.

Facet: A smaller flatter smooth surface that functions as a source of attachment for other structures.

Notch: An area of bone that appears to be cut out and allows for the passage of other structures such as blood vessels or nerves.

Foramen: A hole in the bone that allows a nerve or blood vessel to pass through.



Joints

A joint (articulation) is the place where two or more bones join together.

Two major forms of joints:

- Diarthrodial
- Synarthrodial

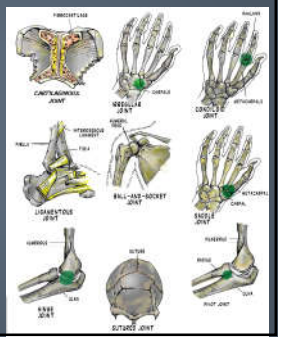
Diarthrodial Joints

Also known as synovial joints.

These are the joints where the most movement occurs.

Divided into six different subdivisions by their shape:

- Hinge
- Ball and Socket
- Irregular
- Condyloid
- Saddle
- Pivot



Diarthrodial Joints Cont.

Hinge Joint: This joint has one concave surface, with the other surface looking like a spool of thread. The elbow joint is an example of a hinge joint.

Ball and Socket: This joint consists of the rounded head of one bone fitting into the cup-like cavity of another bone. It is capable of movement in 3 planes of motion. Both the hip and the shoulder joint are examples of a ball and socket.

Irregular joint: This joint consists of irregularly shaped surfaces that are typically either flat or slightly rounded. Carpals (the joints between the bones of the wrist) are an example of an irregular joint.

Diarthrodial Joints Cont.

Condyloid Joint: This type of joint consists of one convex surface fitting into a concave surface, it is similar to the ball and socket but the condyloid joint is only capable of movement in two planes of motion. An example is the interphalangeal joints.

Saddle Joint: This type of joint is often considered a modification of the condyloid joint. Both bones have a surface that is convex in one direction and concave in the opposite direction like a saddle. These joints are rare, and the best example is the basal joint between the wrist and thumb (trapeziometacarpal joint).

The Pivot Joint: This joint consists of one bone that rotates about the other bone. An example of a pivot joint is the radius bone rotating on the humerus.

Synarthrodial Joints

Unlike diarthrodial joints, synarthrodial joints have no separation or joint cavity. There are three subdivisions of synarthrodial joints:

- Sutured
- Cartilaginous
- Ligamentous

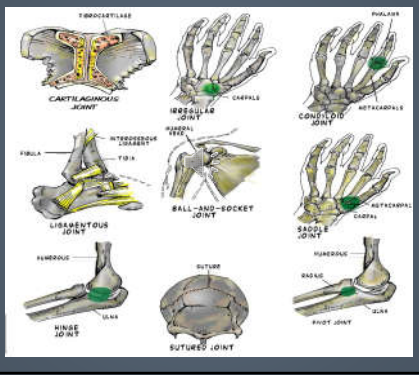
Synarthrodial Joints Cont.

Sutured Joint: This joint has no detectable movement and appears to be sewn together like a seam in clothing. The bones of the skull are the classic examples of a sutured joint.

Cartilaginous Joint: This joint allows some movement, but cartilaginous joints other than those of the spinal column do not play a major role in movement. This type of joint contains fibrocartilage that deforms to all movement between bones and also acts as a shock absorber between them.

Ligamentous Joint: This joint ties bones together where there is very limited or no movement. The joints between two structures of the same bone, like between the shafts of the forearm and the lower leg are example of ligamentous joints.

Joints



Muscles

Muscle tissue is often categorized into 3 types:

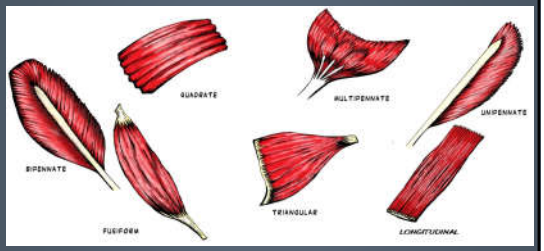
- Smooth: Muscle tissue which occurs in various internal organs and vessels.
- Cardiac: Muscle tissue which is unique to the heart.
- Skeletal: Muscle tissue which causes voluntary movement of the bones and the joints.

Skeletal Muscle

There are 7 types of skeletal muscle

- Fusiform - a muscle that has the shape of a spindle, which is wider in the middle and narrows at both ends. Greater range of motion, limited strength (biceps brachii)
- Quadrate - a muscle that is square shaped with directly parallel fibers (pronator quadratus)
- Triangular – a wide origin that converges to a narrow insertion resembling a triangular shape (infraspinatus)
- Unipennate - fibers are on the same side of the tendon (lumbricals)
- Bipennate - fibers on both sides of the central tendon (rectus femoris)
- Longitudinal - parallel fibers consisting of tendinous intersections that run perpendicular to the direction of the fibers (rectus abdominus)
- Multipennate - central tendon branches within a pennate muscle (deltoid)

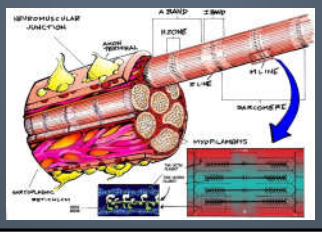
Skeletal Muscle



*Most skeletal muscles are either fusiform or pennate fibers.

General Structure of Skeletal Muscle

Skeletal muscle is encased by a form of connective tissue known as the epimysium.
Within the epimysium are numerous bundles of muscle fibers that are individually wrapped in a fibrous sheath known as the perimysium.
Within the perimysium are muscle fibers, which are in turn enclosed in a connective sheath known as the endomysium.



Skeletal Muscle Structure Cont.

A muscle fiber consists of a number of myofibrils, which are the contractile elements of muscle.

Individual myofibrils are enclosed by a viscous material known as sarcoplasm and wrapped in a membrane known as the sarcolemma.

Lengthwise, myofibrils consist of bands of alternating dark and light filaments of contractile protein known as actin and myosin.

Skeletal Muscle Structure Cont.

A myofibril is divided into a series of sarcomeres, which are considered the functional units of the skeletal muscle.

Sarcomeres contain an I-band, the light colored portion where the protein filament actin occurs.

Sarcomeres also contain an A-band, the dark colored area where the protein filament myosin occurs.

The sarcomere is that portion of a myofibril that appears between two Z-lines.

Skeletal Muscle Fibers

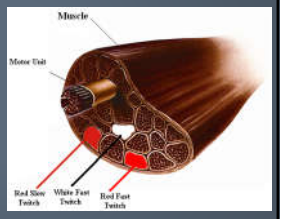
There are two primary types of skeletal muscle fibers: fast twitch and slow twitch.

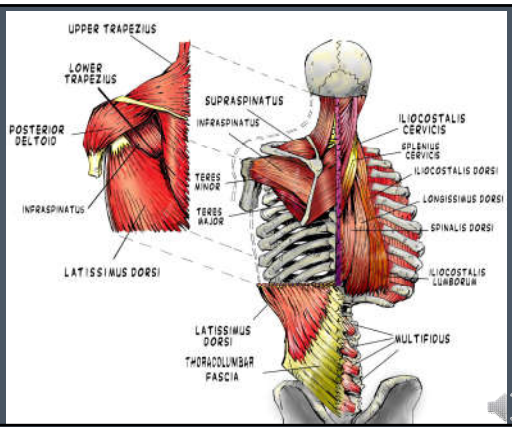
Most muscles contain both types of fibers, but depending on heredity, function, and to a lesser degree, training, some muscles may contain more of one type of fiber than the other.

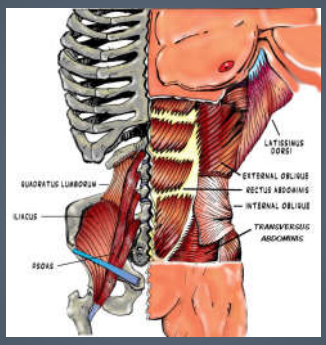
Skeletal Muscle Fibers Cont.

Fast Twitch Muscle Fibers: These muscle fibers are large and white and appear in muscles used to perform strength activities.

Slow Twitch Muscle Fibers: These muscle fibers are small and darker(red) than the fast twitch fibers. They are slow to fatigue and are prevalent in muscles involved in performing endurance activities.







Nerves

The nervous system has three main categories:

- Central Nervous System
- Peripheral Nervous System
- Autonomic Nervous System

Nerves Cont.

The Central Nervous System: consists of the brain and spinal cord.

The Peripheral Nervous System: consists of 12 pairs of cranial nerves and 31 pairs of spinal nerves.

The Autonomic Nervous System: Is divided into two parts, parasympathetic and sympathetic. It is involved in the involuntary function of the organs, glands and smooth muscle tissue.

Nerves Cont.

The nerve cell, or neuron, consists of a cell body and projections from it, which are known as the dendrite and axon.

The dendrite receives information from the surrounding tissue and conducts the impulse to it's cell body.

The axon conducts the nerve impulse from the cell body to the muscle fibers.

Motor nerves carry impulses **from** the central nervous system to the target muscles via the peripheral nervous system.

Sensory nerves carry impulses ***to*** the central nervous system from the peripheral nervous system.

Blood Vessels

The blood vessels bring nutrients and oxygen to the muscle tissue and carry away waste products.

When the heart pumps, blood moves through a huge vascular tree consisting of arteries, arterioles (smaller arteries), capillaries, veins, and venules (smaller veins)

Blood Vessels Cont.

The arteries and arterioles distribute blood to the tissues.

Capillaries are the exchange centers where nutrient/oxygen rich blood enters the cells and waste leaves the cells to be carried away.

The veins and venules collect the blood from the capillaries and return it to the heart. The veins contain small valves that permit blood to flow in only one direction.

Because the veins have to work against gravity, the skeletal muscles act as muscular venous pumps that squeeze blood upward past each valve.

Movement is essential for healthy circulation!

Bursa

Bursa is a saclike structure that contains lubricating fluid to reduce friction between tissue.

It protects the muscle, tendon, ligament, and other tissues as they cross the bony prominences described earlier.

The bursa allow tendons to glide directly over bone without being worn away over time from friction.

Fascia

Fascia is a form of connective tissue that covers, connects, and supports other tissues.

Fascia connects every structure in the body

It is a major communication network

Fascia transmits mechanical energy throughout the body

Fascia houses mechanoreceptors that provide the brain with sensory and proprioceptive feedback

This system plays a significant role in coordination of muscle activity

Types of Fascia

Superficial
Deep
Visceral or parietal

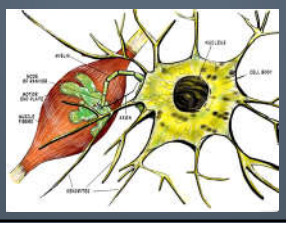
Primarily made of collagen
Fascia runs throughout the body

Motor Unit

A motor unit is defined as a motor nerve and all the muscle fibers it supplies.

The structural parts of the motor unit are the motor nerve and the muscle fiber.

All of the motor units together are referred to as the body's neuromuscular system.



Motor Unit Cont.

The motor unit functions by the impulse from the motor nerve crossing the synapse at the myoneural junction.

This activates the release of calcium through the sarcoplasmic reticulum and transverse tubules causing the cross-bridges of the myosin protein filament to contact the actin protein filaments.

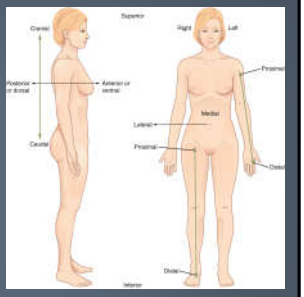
Movement of the actin filaments toward the center of the sarcomere is then produced, thus shortening the sarcomere.

Motor units differ widely in the number of muscle fibers innervated by one motor nerve. The ratio of muscle fibers per motor nerve can range from as low as 10 muscle fibers to as high as 2000 muscle fibers per one motor nerve.

Movement

Anatomical Locations

- Superior
- Inferior
- Lateral
- Medial
- Anterior
- Posterior
- Proximal
- Distal



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Planes of Motion

Human movement takes place from a starting (anatomical) position.

Axis: A straight line around which and object rotates.

Three planes of motion

•Sagittal

•Transverse (horizontal)

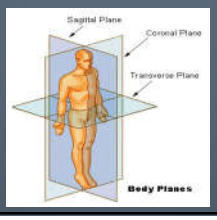
•Frontal (coronal)

Planes of Motion

Sagittal Plane: Passes from the front through the back of the body, creating a left and a right side of the body.

Transverse (horizontal) Plane: Passes through the body horizontally to create top and bottom segments of the body.

Frontal Plane (coronal): Passes from one side of the body to the other, creating a front side and a back side of the body.



Fundamental Movements

In the sagittal plane, the fundamental movements are known as flexion and extension.

Flexion: Decreasing the angle formed by the bones of the joint.

Extension: Increasing the angle formed by the bones of the joint.

In the frontal plane, the fundamental movements are abduction and adduction.

Abduction: Movement away from the midline of the body.

Adduction: Movement towards the midline of the body.

In the transverse (horizontal) plane the fundamental movement is simply rotation.

Internal rotation: Rotation towards the midline of the body.

External rotation: Rotation away from the midline of the body.

Part 2: Functional Evaluation Tests

- Balance
- Coordination
- Posture
- Muscle Activation Patterns
- Strength/Endurance
- Flexibility

Every test is an exercise and every exercise is a test.