Mechanism of Body Movement

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Movement is the Sign of Survival for Life
The Science of Movement

- Kinesiology is the study of the human body during movement. There are many disciplines within kinesiology including anatomy, neuromuscular physiology, and biomechanics.

- Biomechanics is part of kinesiology that deals with the investigation and application of mechanics to human body
Structures Implied in Movement

• Bones
• Joints
• Muscles
• Brain and nerve
Bone Functions in Movement

• Support
• Levers & linkages that allow for movement
• Shock absorption, force transmission
• Provide broad surfaces for muscle attachment
• Support weight
• Dissipate loads
• Alter angle of muscle insertion
Types of Bones

Long bones
Short bones
Flat bones
Irregular bones
Sesamoid bones
Types of Joints

• Immovable
  – Skull
  – Pelvis

• Moveable
  – Hinge
  – Gliding
  – Pivot
  – Saddle
  – Ball & Socket
  – Condyloid

With each movable joint comes a set of muscles.
Muscle have origin and insertion usually into bone.
Muscles of the Body
Functions of Muscles

• Produce movement
• Maintain postures and positions
• Stabilize joints
Types of Muscle

- Pectoralis major
- Orbicularis oris
- Deltoid
- Sartorius
- Extensor digitorum longus
- Biceps brachii
- Fusiform
- Rectus femoris
- Unipennate
- Bipennate
How Does Muscle Move a Joint?

- Muscle fibers generate force
- The force is vector sum of the forces of its fibers
- The magnitude of that force is often erroneously called “force”
- The direction of that force is called “Force Generating Axis”
Joint Motions

- Abduction
- Adduction
- Flexion
- Extension
- Hyperextension
- Circumduction
- Internal Rotation
- External Rotation
- Horizontal adduction
- Horizontal abduction
- Plantarflexion
- Dorsiflexion
- Inversion
- Eversion
- Right/left tilt
Planes of Movement

Figure 3.14: The three planes of the human body in movement.
Kinematic and Kinetic

- **Kinematic:**
  Analysis of motion/movement allowed by organism body

- **Kinetic:**
  Analysis of forces involved in organism motion/movement
Head and Neck Kinematic

Flexion  Hyperextension  Lateral Flexion  Rotation
Shoulder Joint Kinematic

Fig. 6-2. Basic movements of skeleton: neck and shoulders.
Arm and Hand Kinematic
Trunk Kinematic

- Hyperextension of spine
- Rotation of trunk
- Body flexion
- Lateral flexion of spine
Upper and Lower Leg Kinematic
Hand and Foot Kinematic

Abduction  Adduction  Flexion  Extension  Opposition of thumb

Flexion  Dorsal flexion

Foot  Extension

Plantar flexion

120°

35°  25°

Inversion  Eversion
Brain

Premotor cortex organizes movement sequences.

Prefrontal cortex plans movements.

Motor cortex produces specific movements.

Prefrontal cortex plans sequences.

Premotor cortex executes actions.
1. Visual information required to locate target.
2. Frontal-lobe motor areas plan the reach and command the movement.
3. Spinal cord carries information to hand.
4. Motor neurons carry message to muscles of the hand and forearm.
5. Sensory receptors on the fingers send message to sensory cortex saying that the cup has been grasped.
7. Basal ganglia judge grasp forces, and cerebellum corrects movement errors.
8. Sensory cortex receives the message that the cup has been grasped.
Roles of Muscle in Movement

Agonist
• Muscle that produces desired movement

Antagonist
• Oppose motion of agonist

Stabilizer
• Muscles that act in one segment so that movement in an adjacent segment can occur

Neutralizer
• Muscles that eliminate an undesired action of another muscle
Muscle Actions

**CONCENTRIC**
Deltoid shortens to raise arm in abduction

**ECCENTRIC**
Deltoid lengthens to lower arm in abduction

**ISOMETRIC**
Deltoid holds arm in abduction
Muscle Attachment

A. Coracobrachialis

B. Long head-triceps

C. Palmaris longus

Direct

Tendon

Aponeurosis
Levers in the Human Body

• Lever is a rigid bar rotating on an axis
• Fulcrum (axis)- point of support, axis of rotation
• Moment arm- perpendicular distance from line of action of a force to the axis of rotation
• Torque (moment)
Lever Systems

• First Class

• Second Class

• Third Class
First Class Lever

- A lever in which the muscular force and resistance force act on **opposite** sides of the fulcrum
Second Class Lever

• A lever in which the muscle force and resistance force act on the same side of the fulcrum, but the resistance force acts at a point closer to the fulcrum than the muscle force.
Third Class Lever

• A lever in which the muscle force and resistance force act on the same side of the fulcrum, but the muscle force acts at a point closer to the fulcrum than the resistance force.
Movement

• Basic movement:
  walk, run, jump, throw, catch, strike etc

• Goal oriented movement:
  writing, typing, bicycling etc

• Adaptive movement:
  use of prosthetics, crutches etc
Walking
Walking
Running
Running
Jump Forward
Jump Upward
Summary

• Movement is a complex process involving bones, muscles, joints, brain and nerve working in harmony
• Body movement consists of body segment motions
• Structure defines movement or movement defines structure?
• Study of human movement is a frontier in health and medical sciences
Movement is universal need of mankind