Biomechanics

Third Stage/ Biomaterials Engineering and prosthesis Branch

Presented By

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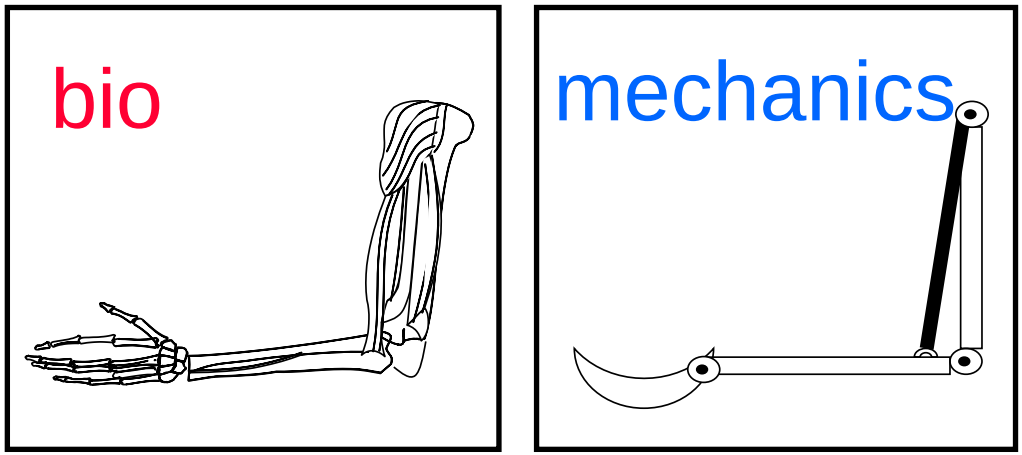
Lecture One

Introduction

What is biomechanics?



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- Is the scientific study of the mechanics of biological systems.

Biomechanics

- Biomechanics is be used to:

- To understand the biomechanical analysis (motion) (Gait cycle) (for normal and patient human).
- To understand function of vascular system in order to analysis the fluid biomechanics (blood flow).
- To analysis the biomechanics of :
  - soft tissue (muscle)
  - hart tissue (bones).
- To model these systems to aid in the design of prosthetic devices (e.g. artificial artery or artificial limb)

Biomechanics

Engineering
(Mechanics)

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Anatomy

Physiology

Applications Biomechanics

-Improved the performance (Human movement)
- Preventing or treating injury
- Design prosthesis & orthosis or artificial limb

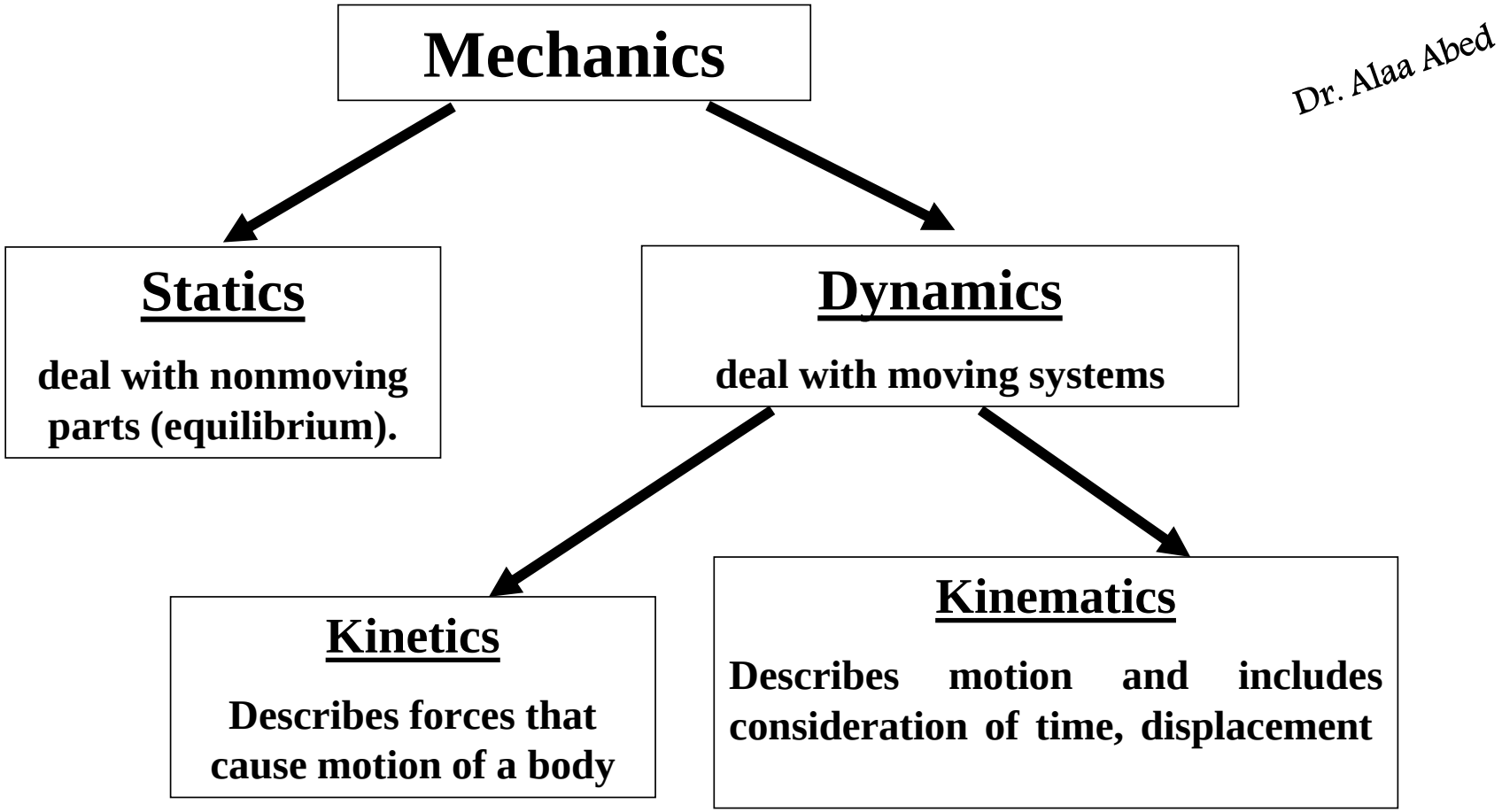
- Biomechanics is based on NEWTON'S LAWS and involves the study of the motion of bodies and the interrelationships among the forces acting on these bodies.
- BIOMECHANICS: BIO = LIVING

  MECHANICS = FORCES & EFFECTS

- Involves the principles of anatomy and physics in the descriptions and analysis of movement.
- The study of biological structures, processes and functions by applying the methods and principles of mechanics.
- The science that examines the internal and external forces acting on the body and the effects produced by these forces.
- KINETICS & KINEMATICS

Branches of Biomechanics (Mechanics)

- **Mechanics**: study of forces and motions for the body.



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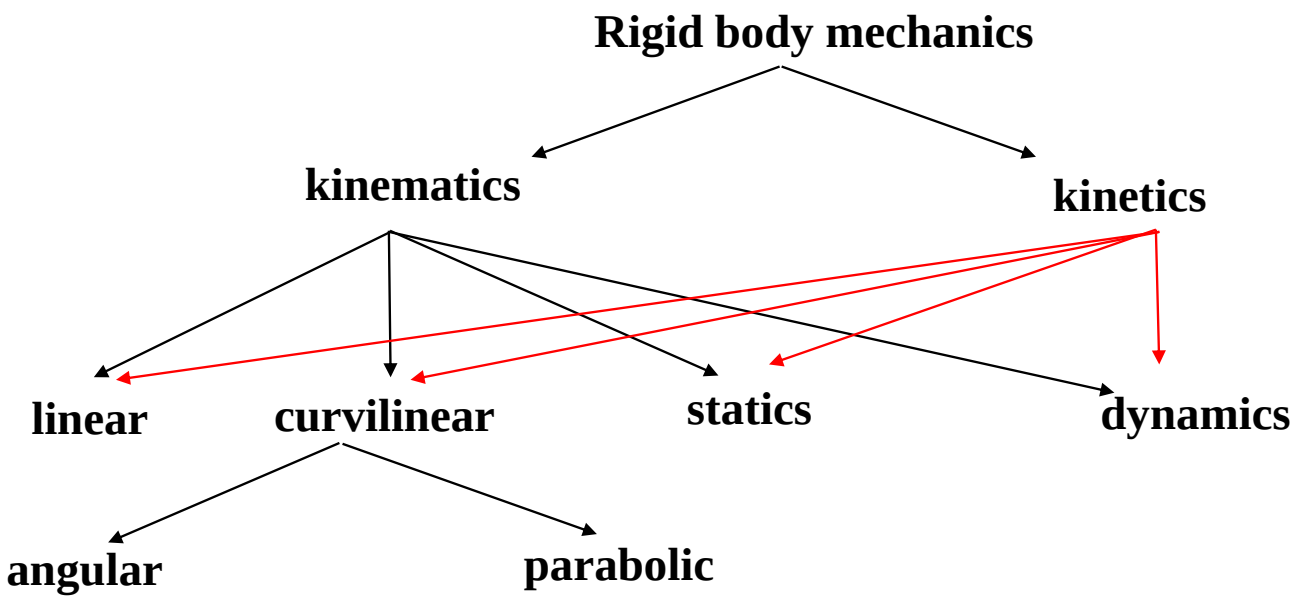
Classification of mechanics



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Basic Biomechanics

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Kinematic Analysis

What is anatomical reference position?

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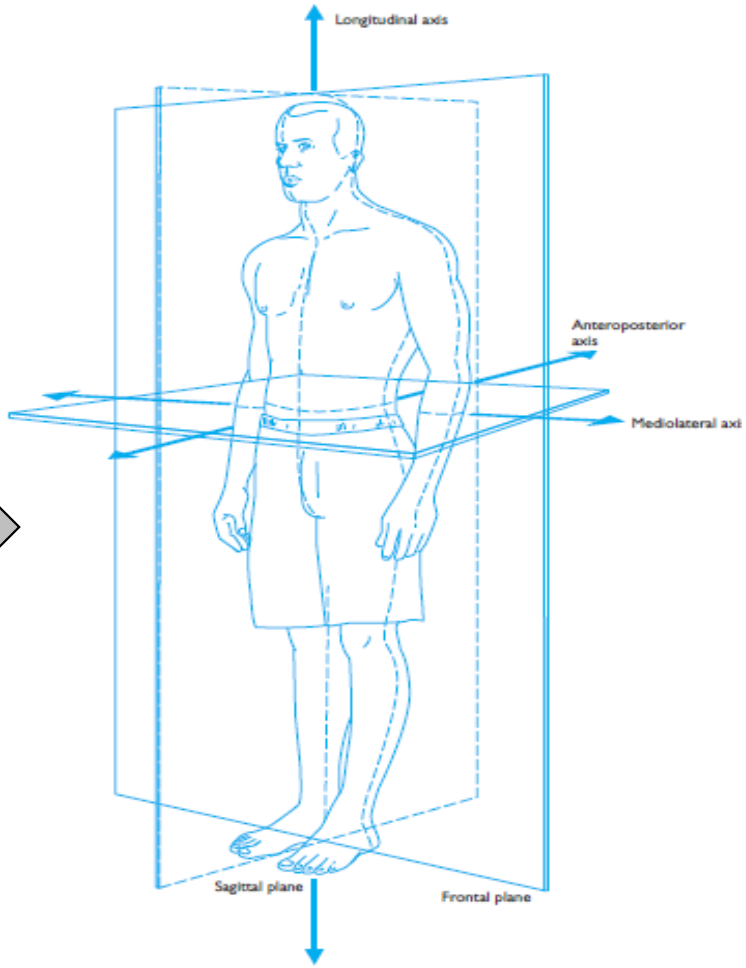
- straight standing position with all body parts facing forward.
- considered the starting point for all body segment movements.

Main Planes and Axis



Directional terms:

- **superior:** closer to the head
- **inferior:** farther away from the head
- **anterior:** toward the front of the body
- **posterior:** toward the back of the body
- **medial:** toward the midline of the body
- **lateral:** away form the midline of the body
- **proximal:** closer to the trunk
- **distal:** away from the trunk
- **superficial:** toward the surface of the body
- **deep:** inside the body away from the surface

Reference planes:

- **sagittal plane**: in which forward and backward movements occur.
- **frontal plane**: in which lateral movements occur.
- **transverse plane**: in which rotational movements occur.

Reference axes

- **mediolateral axis :**around which rotations in the sagittal plane occur.
- **anteroposterior axis** : around which rotations in the sagittal plane occur.
- **longitudinal axis** : around which rotational movements occur.

Forms of Motion

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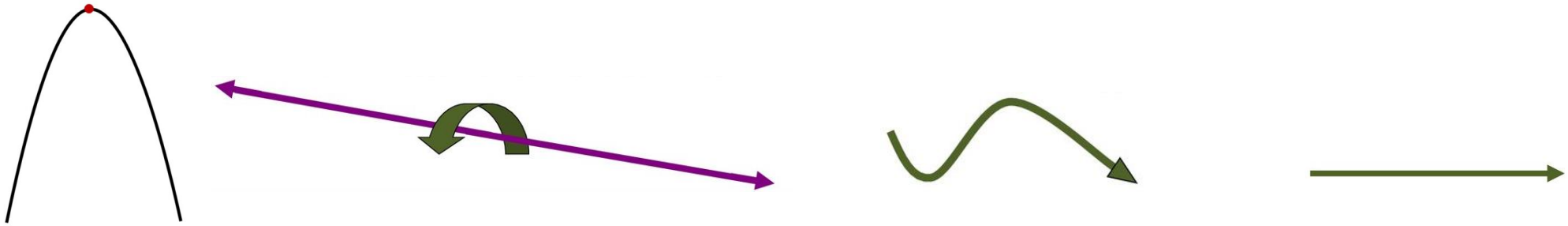
- **Linear Motion**: is the movement of a body in a straight line or along a straight pathway. Linear motion is also produced when external forces are applied directly through the centre of mass of an body.
- **Curvilinear motion:** Motion along a curved path.
- **Angular:** rotation around an axis.
- **Parabolic**: Bodies which are projected into the air will assume a **PARABOLIC PATH** and are governed by the laws of projectile motion.



Parabolic **Angular** **curvilinear** **Linear**

- **General motion**: a combination of linear and angular motion (includes most human motion)

mechanical system

- **Mechanical System**: is a body or portion of a body that is deliberately chosen by the analyst.
- **examples**: throwing arm, kicking leg, the trunk during performance of a lift, the entire body during performance of a maximal vertical jump.

movements occur in the sagittal plane:

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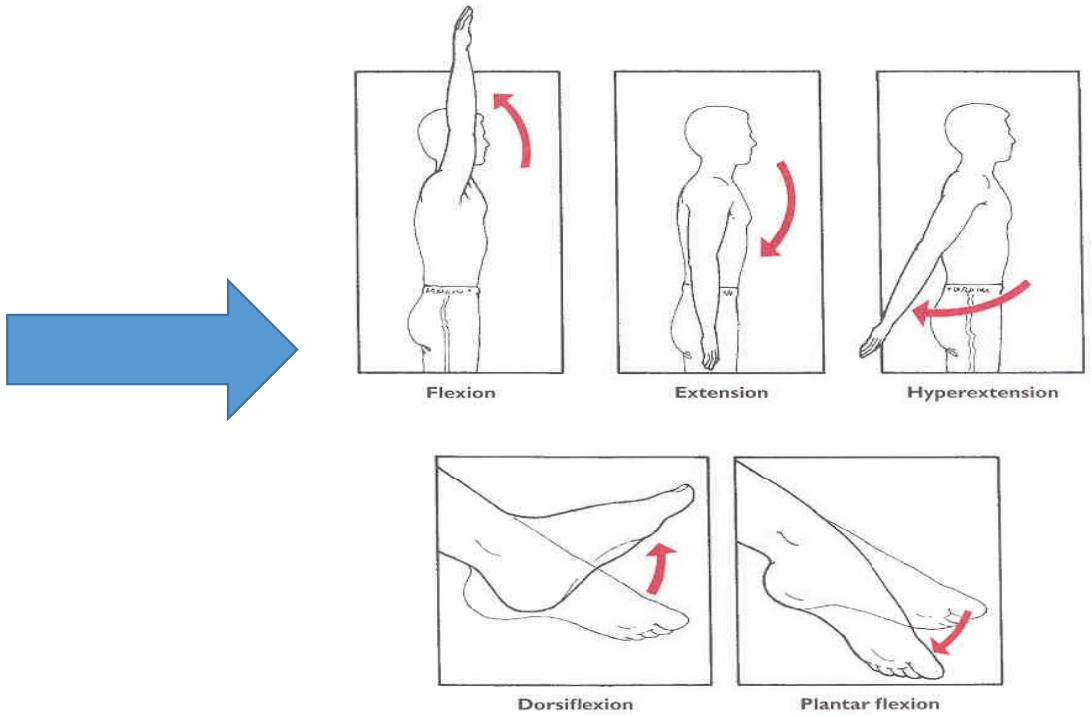
- flexion
- extension
- hyperextension
- dorsiflexion
- plantar flexion



movements occur in the frontal plane:

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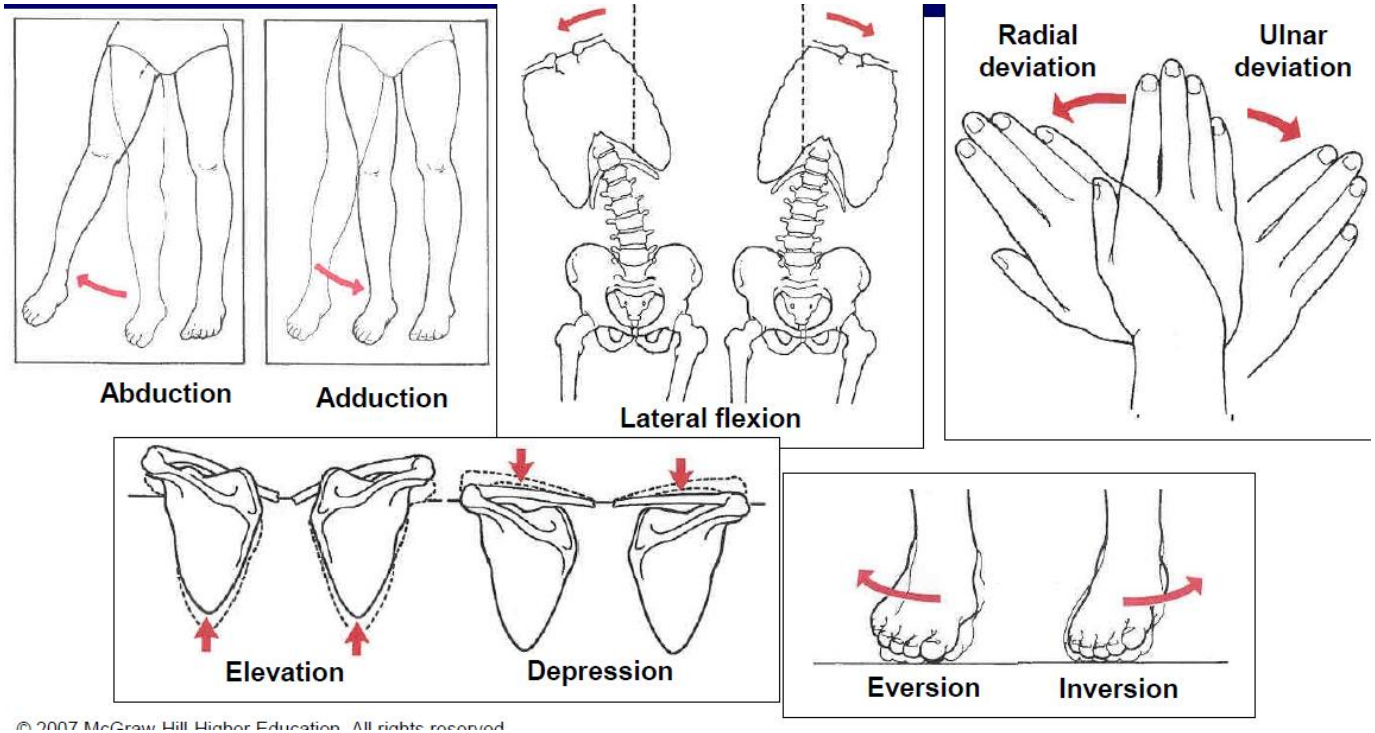
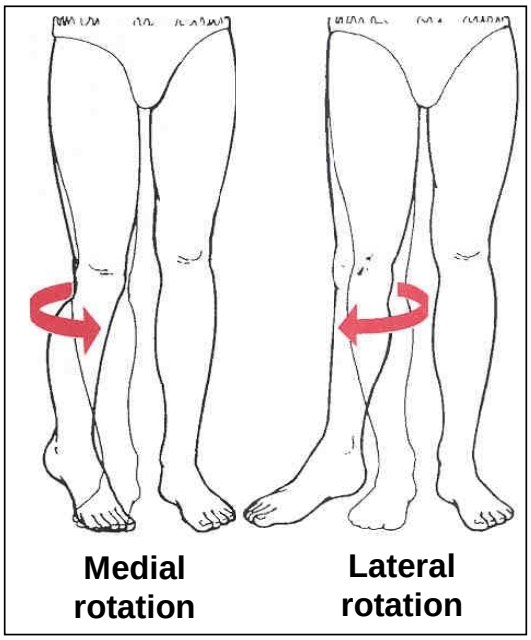
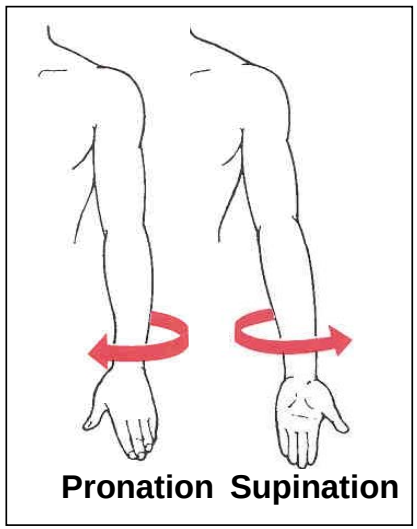
- abduction & adduction
- lateral flexion
- elevation & depression
- inversion & eversion
- radial & ulnar deviation

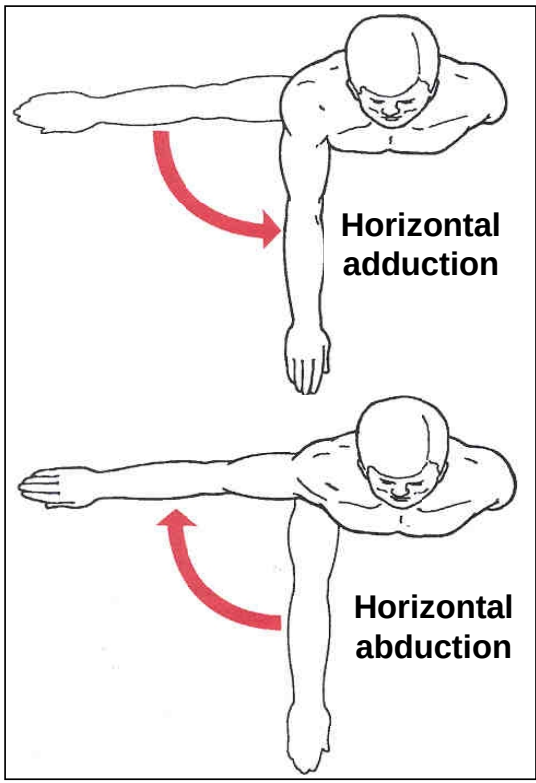


movements occur in the transverse plane:

- left & right rotation
- medial & lateral rotation
- supination & pronation
- horizontal abduction & adduction







Principles associated to biomechanical analysis

- Balance and stability
- Centre of gravity
- Elasticity
- Forces (action & reaction)
- pressure
- power
- Bending moment
- Torque moment
- Friction
- Wear
- Density
- Momentum
- Velocity
- Time
- Acceleration
- Deceleration
- Mass
- Inertia
- Dimensions
- Viscosity

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Tools for Measuring Kinematic Quantities

- **1. Video and Film**

  employing cameras in the study of human and animal movement.

- **2. Accelerometer Transducer**
  - used for the direct measurement of acceleration.

Main Branches of Human Biomechanics

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1- kinesiology: the study of human movement.

2- Sports medicine: is an umbrella term that includes both clinical and scientific aspects of exercise and sport

Qualitative vs. Quantitative

- qualitative: pertaining to quality (without the use of numbers)

  Example: Good ,Long ,slow , heavy

- quantitative: involving numbers

  Example :2 m , 4.5 sec , 8 turns

The End of Lecture