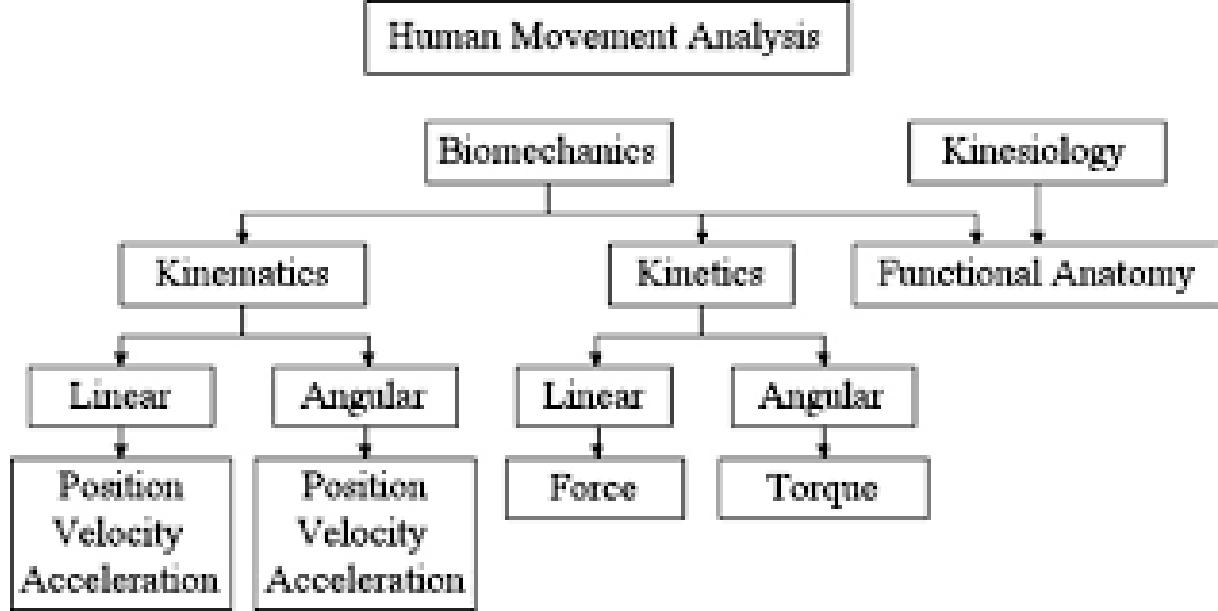


1.2 Mechanical Terminologies



Mechanics is a branch of science that deals with forces and the effects produced by these forces.

The application of this science to the biological system is referred to as biomechanics.

- Human biomechanics focuses on how forces act on the musculoskeletal system and how the body tissue responds to these forces.
- Using the forces involved in the production of movement and posture, biomechanics can be viewed in the context of either external or internal biomechanics.

1.

1. External biomechanics describes external forces on body segments and their effect on body movement,
2. Internal biomechanics are forces generated by the body tissues and their effect on movement. "This included the muscle forces and the forces in bones and joints that result from transmission of the muscle forces through the skeleton".

External Forces (External Biomechanics)

Mechanics Domain

There are two domains of mechanics (biomechanics):

1. Static: describes mechanics that analyse the bodies at rest or in uniform motion
2. Dynamics: the study of conditions under which an object moves.

The dynamics concept can be further discussed under kinematics and kinetics.

- The kinetics concept: deals with body motion and the forces that cause it to move.

- Kinematics describes: body motion without regard to the forces that produce that motion.

Kinematics Variables

In kinematics, there are five variables of interest:

1. Type of motion or displacement,
2. The location,
3. The direction,
4. The magnitude
5. Rate of the motion or displacement.

1. Type of motion

Human motion is described as general motion (a complex combination of linear and angular components of motion). Most of the time human motion is analysed as either linear or angular motion as these two types of motion are basically considered “pure” motion.

- Linear motion (or translatory or translational motion): all parts of the body are moving in the same direction and at the same speed. If this motion occurs along a straight line it is referred to as linear or rectilinear motion; a curved path it is referred to as curvilinear path.
- Angular motion is described as a rotation that occurs around a central imaginary line known as the rotation axis.

Pure linear movement in humans, like in walking, running and swimming rarely occur as the orientation of body segments to each other changes continually.

- In activities like skating and ski jumping there might be brief moments of pure linear motion.

The movement of a multi-segmented body, like the human body, which involves simultaneous linear and angular motion of the segments, is usually referred to as general motion. In humans, whole-body movements are described as general motion, as explained in the following examples

- When a person walks, the head and trunk movements are fairly linear, but the legs and arms movements are linear and angular simultaneously as the person's body translates forward
- In cycling, the head, trunk and arms move in a fairly linear fashion but the legs move simultaneously in a linear and angular motion.

2. Magnitude of Motion

For angular motion, its magnitude can be measured and recorded in radians or degrees with the use of a goniometer. While the linear motion of a segment is measured by the linear distance that the object covered and this can be evaluated with walking assessment tools like 6-minute walk test.

3. Rate of Motion

Speed or velocity is used to measure the rate of motion and change in velocity is acceleration.

4. Location of Joint Motion in Space

One common reference system for location joint motion is that of anatomical planes and axes. A plane of motion can be described as a particular dimension of motion that runs through an imaginary flat surface of the body and an axis is an imaginary line that the body segment is rotating about. There are three planes of motion in the body, namely the sagittal, frontal and transverse planes.

- A sagittal plane has its axes as mediolateral, also known as transverse axes
- The frontal (coronal) and transverse planes have their axes as anteroposterior and longitudinal respectively.

5. Direction of Motion

The direction of motion can be described in terms of how the movement occurs along the plane and axis.

- When a motion reduces joint angle in the sagittal plane it is called flexion and a motion that increases the joint angle extension. Other common direction of motion in the sagittal plane are dorsiflexion and planter-flexion.
- Movement to the extremes of the range of motion are often referred to as "hyper," as is the case with hyperextension, and this also occurs in the sagittal plane.
- The motion of a segment away from the midline in the frontal plane is called "abduction," while the movement back toward the midline is called "adduction". Other directions of motion that is common in this plane include eversion and inversion.
- Common motion along the transverse plane are internal rotation and external rotation, pronation and supination are also common motion along the transverse plane.

There are other directional terms to help describe the position of the body segment relative to the anatomical position eg

- Superior and inferior, which describes body position towards the head and the feet, respectively.
- Anterior and posterior can be used to describe objects related to the body as the front or back orientation to the body, respectively.
- Parts or movement towards the midline of the body is called medial, while motion or position towards the sides of the body is lateral.