Revised and Updated

On Board! BOOKS

"My single achievement is that, with my sincere and honest approach, I inculcated the spirit of oneness and togetherness among players."
– BISHAN SINGH BEDI

Includes
COMPETENCY-BASED QUESTIONS (CBQs)
Assertion-Reason Type Questions
Data-Based/Picture-Based/ Case-Based Questions
MCQs

As per the guidelines of NEP 2020

A TEXTBOOK OF

Physical Education

Based on the latest CBSE syllabus

XII

SCAN QR CODE

A TEXTBOOK OF PHYSICAL EDUCATION CLASS 12

Chapter 8

BIOMECHANICS AND SPORTS

An imprint of Ratna Sagar P. Ltd.

MEANING AND IMPORTANCE OF BIOMECHANICS IN SPORTS

Meaning of Biomechanics

"Biomechanics is the study of the Structure and function of biological systems by means of the methods of mechanics."

– H Hatze

"The study and analysis of human movement patterns in sports is called biomechanics."

– Watson

Figure 8.1 Biomechanics helps to describe, explain and predict the mechanical aspects of human exercise, sport and play.

Importance of Biomechanics in Sports

The importance of biomechanics in sports can be outlined as follows:

- Improvement of Equipment and Facilities:
- Minimisation of Injury:
- Development of New Methods:
- Improvement of Training:
- Understanding the Human Body:

TYPES OF MOVEMENTS (Flexion, Extension, Abduction and Adduction)

Plane

It shows the human body in its erect form, the hands slightly spread to the sides, palms facing forward (when the visual is frontal), legs together with the knees straight and feet resting on the ground with the toes pointed straight. This pose is also referred to as anatomical neutral, and the description of movements begins from it.
There are three planes that pass through the human body.

Sagittal Plane: This is a vertical plane that divides the body into two parts: a left part and a right part.
Coronal/Frontal Plane: This plane also runs vertically and separates the body into two halves: back half and front half.
Transverse or Horizontal Plane: This is a horizontal plane that divides the body into the superior and inferior halves.

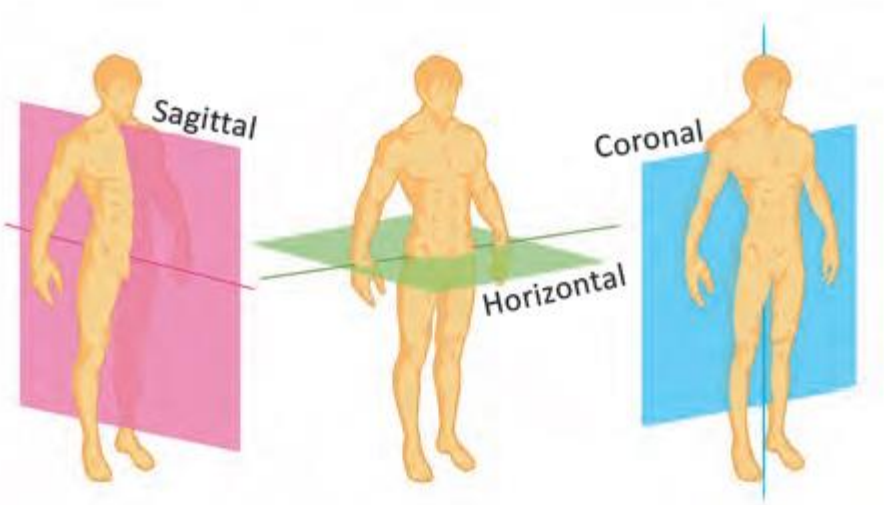

Figure 8.2 Various planes of human body

Axis

An axis is an imaginary straight line about which a body rotates. Movement at the joint takes place in a plane about an axis.

There are three kinds of axis:

1. Sagittal or Anteroposterior Axis: It runs from the back to the front horizontally, and is formed by the intersection of the sagittal and transverse planes. It is perpendicular to the coronal plane.

2. Frontal or Medio-lateral Axis: It runs from the left to the right horizontally and is formed by the intersection of the frontal and transverse planes. It is perpendicular to the sagittal plane.

3. Vertical or Longitudinal Axis: It runs from the upper to the lower half vertically and is formed

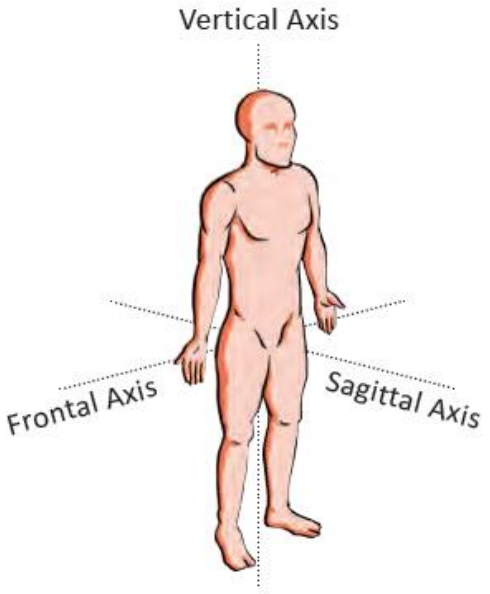

Figure 8.3 Various axes of human body

The Image of Human Anatomy

Human anatomy is often represented by the following diagram:

Figure 8.4 The human anatomy

Flexion

Flexion is a movement that decreases the angle between two body parts.

Extension

Unlike flexion, extension increases the angle between two body parts. When the elbow extends, the angle between the ulna and the humerus increases until an angle of 180° is reached and the arm becomes straight.

Figure 8.5 Flexion and extension

Abduction

Abduction is a movement in the frontal plane that takes the body part away from the midline or towards an imaginary centre line.

Adduction

Adduction is a movement in the frontal plane that returns the body part to the midline or takes it away from the imaginary centre line. Adducting the fingers bring them together.

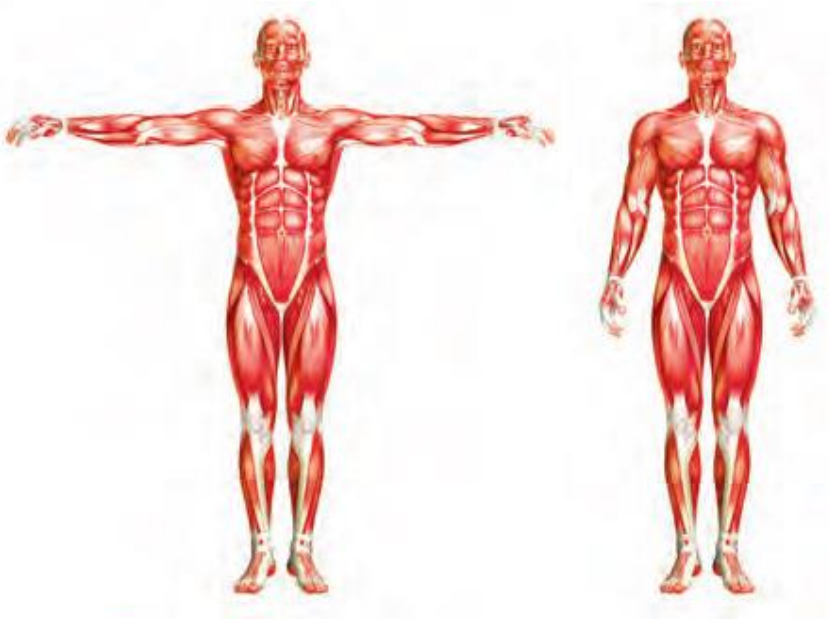

Figure 8.6 Abduction and adduction

Table 8.1 Planes and associated movements

Plane	Motion	Axis	Gross Movements
Sagittal	Flexion/ extension	Frontal	Walking and squatting
Frontal	Abduction/ adduction	Sagittal	Star jump
	Side flexion		Lateral arm rise
Transverse	Internal rotation/ external rotation	Vertical	Throwing
	Horizontal flexion/ extension		Baseball swing

NEWTON'S LAW OF MOTION AND ITS APPLICATION IN SPORTS

Three Laws of Motion and Their Application

The First Law (Law of Inertia): *A body at rest will continue in its state of rest and a body in motion will remain in its state of uniform motion in the same direction, unless an external force acts on them.*

This law is used in the starting techniques of sports such as rowing, sprinting, hammer throw, etc. and landing in gymnastics

Figure 8.7 Newton's first law is used in sprinting.

Three Laws of Motion and Their Application

The Second Law (Law of Acceleration): *A change in acceleration of a body is directly proportional to the force acting on it and inversely proportional to the mass of the body.*

This is shown by the formula:

$$F = m\,a$$

An example can be taken of batting in cricket. When a ball is hit, the change in speed depends on the force (*F*) with which it has been hit.

Figure 8.8 Application of Newton's second law of motion in cricket.

Three Laws of Motion and Their Application

The Third Law (Law of Reaction or Law of Counterforce): *For every action, there is always an equal and opposite reaction.*

This law is pivotal in understanding the biomechanics involved in sports like swimming, shooting, high jump, basketball, etc. In swimming, for example, the swimmer will be propelled at greater speed when she/he pushes the water with more force. Hard ground is more suitable for high jumps in comparison to sand because a hard surface reacts with greater force.

Figure 8.9 Application of Newton's third law of motion in swimming.

SUMMARY

1. It has been defined as the science that deals with the study of the effects produced by internal and external forces when they act on a biological system.

2. With detailed analysis of physical movements in sports biomechanics, the flaw can be rooted out from within the source itself.

3. Flexion, extension, abduction and adduction are some of the major movements executed by the human body. Flexion and extension occur in the sagittal plane, while abduction and adduction occur in the frontal plane.

4. Abduction is a movement in the frontal plane that takes the body part away from the midline or towards an imaginary centre line.

5. Adduction is a movement in the frontal plane that returns the body part to the midline or takes it away from the imaginary centre line.

6. Newton proposed three laws of motion that now help us understand the biomechanics involved in sports.