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Summary 80
Human Anatomy: The Pieces of the Body Puzzle

After completing this chapter you should be able to:

- demonstrate an understanding of the basis for anatomical description and analysis;
- use correct anatomical terminology when describing the human body and performance;
- describe the various parts of the skeletal and muscular systems and the ways in which they relate to human performance;
- demonstrate an understanding of the organization and complexity of human anatomy.
The human body has fascinated the human mind for centuries. What enables us to run, jump, and throw? How are we able to move our fingers with such remarkable dexterity? What are the structures that allow us to perform the myriad of tasks we do? The study of the structures that make up the human body, and how those structures relate to each other, is called human anatomy. Questions concerning human anatomy continue to capture the curiosity of human beings worldwide because it is a subject that binds all humans together. An understanding of how our bodies are structured to perform is important if we are to gain our full potential, especially in the world of sport and physical activity.

It is important to realize that structure often determines function; the structures of the human body are well designed for efficient movement. You have probably marvelled at the strength of the human skeleton, which is able to withstand great impact and stress, not to mention its light weight that allows movements to be swift and active. The human body is undoubtedly a strong, flexible, well-oiled machine, able to move and perform with astonishing efficiency (Figure 3.1). But what structures allow some power lifters to lift weights two or three times their own body weight? How does Tyson Gay run a distance of 100 meters under 10 seconds?

In fact, how are we able to stand upright and move against gravity and other forces? The science of anatomy attempts to shed light on these and other questions, as well as to provide answers based on the complex and intricate structure of the human body.

Many systems make up the human body. Some of them are the respiratory, urogenital, cardiovascular, nervous, endocrine, digestive, and musculoskeletal. The cardiovascular and nervous systems are essential to the musculoskeletal system. In this chapter we will deal with the musculoskeletal system.

Figure 3.1 The human body is capable of moving gracefully and performing very challenging tasks.
Terms and Concepts Worth Knowing

In order to describe anatomy with clarity, there is a certain language or terminology to be learned. The language of anatomy may be difficult to grasp at first because it is largely unfamiliar to you; but once you gain a general understanding of the word roots, suffixes, and prefixes commonly used in anatomy, the terminology will become increasingly meaningful. For example, if you know that *myo* refers to muscle and that *cardio* pertains to the heart, you can reach the conclusion that *myocardium* refers to the muscle of the heart. The knowledge of some basic terms and concepts is invaluable for improving your understanding of anatomy.

**Anatomical Position**

Of particular importance to studying anatomy is the basic anatomical position. It is used in all anatomical description, specifying the locations of specific parts of the body relative to other body parts; it can best be learned by you, the student, in the following position: standing erect, facing forward, arms hanging at the sides with palms facing forward, legs straight, and heels and feet together and parallel to each other. The anatomical position is universally accepted as the starting reference point for describing the human body (Figure 3.2).

**Directional Terms**

In the anatomical position, your nose is medial to your eyes, your ears are lateral to your cheeks, your skin lies superficial to your muscles, your heart is deep to your rib cage, your lips are anterior (ventral) to your teeth, your back is posterior (dorsal) to your abdomen, and your lips are superior to your chin. Also, the hands are distal to the arms, and the arms are proximal to the hands. The terms proximal and distal are also used to describe nerves and blood vessels, proximal meaning “toward the origin” and distal meaning “away from the origin.” A person lying on his back is supine and when lying face down is said to be in a prone position (e.g., when preparing to perform a push-up).

Each of the terms described here indicates the location of a body part or position in relation to another part of the body, giving a clear indication of where body parts may be found. If you want to locate the abdomen, for example, you would say, “The abdomen is inferior to the thorax,” rather than saying, “The abdomen is below the thorax.” It is important to note, however, that directional terms are based on the assumption that the body is in the anatomical position (Figure 3.2).

**Planes of the body**

In addition to directional terms, there are certain planes (imaginary flat surfaces) that need to be defined and understood;
**Directional Terms**

**Superior** – Nearer to the head  
The head is superior to the thorax.

**Inferior** – Nearer to the feet  
The stomach is inferior to the heart.

**Anterior (Ventral)** – Nearer to the front  
The quadriceps are anterior to the hamstrings.

**Posterior (Dorsal)** – Nearer to the back  
The hamstrings are posterior to the quadriceps.

**Superficial** – Nearer to the surface of the body  
The skin is more superficial than muscle.

**Deep** – Farther from the surface of the body  
The heart lies deep to the ribs.

**Medial** – Nearer to the median plane  
The nose is medial to the eyes.

**Lateral** – Farther from the median plane  
The eyes are lateral to the nose.

**Distal** – Farther from the trunk  
The hands are distal to the arms.

**Proximal** – Nearer to the trunk  
The arms are proximal to the hands.

Although many movements do not occur in any one plane, large movements and movements that occur at joints can often be described as being sagittal, frontal, or transverse plane movements; therefore, these reference planes still remain useful for describing human movement.

**Joint Movements**

Most movements are often found in pairs: for every movement, there is generally a movement that is opposite to it. There are exceptions, but the following descriptions apply to most joints and are illustrated in Figure 3.3.

**Flexion–Extension**

This usually occurs in a sagittal plane. In general, **flexion** reduces the angle between two bones at a joint and **extension** increases it. Consider the elbow joint when a biceps curl is performed. Lifting the weight requires flexion (reducing the angle at the joint), while lowering the weight involves extension (increasing the angle at the joint). These terms are modified in certain actions. At the ankle joint, for example, the terms dorsiflexion (motion bringing the top of the foot toward the lower leg or shin) and plantar flexion (“planting” the foot) are used.
Figure 3.3 Anatomical position, directional terms, and planes of the body.
Figure 3.4 Major body movements around joints.
**Abduction–Adduction**

In general, **abduction** is movement away from the midline of the body and **adduction** is movement toward the midline of the body in the frontal plane. The motions of the arms and legs during a jumping jack are examples of these two types of movements.

**Circumduction**

When flexion-extension movements are combined with abduction-adduction movements, a cone of movement occurs but does not include any rotation. Tracing an imaginary circle in the air with your index finger while the rest of the hand remains stationary produces **circumduction**. The tip of your finger represents the base of the cone, while your knuckle forms the apex of this conical motion. This movement can occur at other moving body segments such as the hip and shoulder.

**Rotation**

A bone may also rotate along its longitudinal axis. To illustrate this action, flex your right elbow, place your left hand on your right shoulder, and now rotate your right arm so that your hand is carried toward your abdomen. This movement toward the median plane is called **medial** or **internal rotation**. When you rotate your arm back to the original position or out laterally, this is called **lateral** or **external rotation**.

**Pronation–Supination**

This movement is used to describe movements relative to the forearm and hand. When the palm is moved to face anteriorly, this is **supination** (you can hold a bowl of soup); when the palm is moved to face posteriorly, it is **pronation**. These actions are required when turning a door knob, opening a jar, or performing a topspin shot in tennis.

**Inversion–Eversion**

This movement is relative to the sole of the foot. When the sole is turned inward (as when you “go over” on your ankle) it is inverted: this movement is called **inversion**. Injuries are common at the ankle joint, occurring when the joint is severely inverted beyond its normal range of motion. When the sole is turned outward or away from the median plane of the body, it is everted: this movement is called **eversion**.

**Dorsiflexion–Plantar Flexion**

The movement of the ankle so that the dorsal surface of the foot moves superiorly is called **dorsiflexion**. It is the opposite of **plantar flexion**, which draws the foot inferiorly in the anatomical position. These actions occur when standing on the toes or using the pedals of a car while driving.

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**The Musculoskeletal System**

The musculoskeletal system is composed of three distinct yet interdependent components: the bones, the joints, and the muscles. While each provides its own unique contribution, it is the interaction of these systems that allows human movement to occur. The bones form a rigid skeletal framework with numerous joints that can be moved as a result of the forces produced by the attaching muscles. As the muscles pull against the bones, the bones act as levers that can produce diverse movements in all directions. These three major components work together to make the human body strong, efficient, and capable of moving with grace.

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The forearm and hand must supinate to carry a platter. An easy way to help you remember this is to think about carrying a bowl of soup on a platter. Think: “soup”inate.