

Diane had just begun her clinical rotation at Blue Ridge High School. Because she had a late-afternoon class on Tuesdays and Thursdays, she was able to attend only prepractice preparation on those days. On Wednesday and Friday afternoons, she would often arrive early so that she could read through the injury records documented by her approved clinical instructor (ACI) to learn about any new injuries sustained by athletes during practice or games on those afternoons. Reading through these evaluation notes, she appreciated the importance of using consistent terminology when documenting the injury and evaluation findings so that she had a clear picture of the type and severity of the injury and the associated signs and symptoms.

Clear communication is fundamental to your clinical practice. Proper anatomical reference and injury terminology are essential for communicating effectively with other health professionals and accurately documenting the findings of your examinations. This chapter reviews common anatomical terminology and injury classification systems that will help you both understand this text and clearly articulate the findings of your examinations. With few exceptions, these terms and systems will consistently apply to the different joints and body regions.

ANATOMICAL REFERENCE TERMINOLOGY

The **anatomical position** is the standardized position of the body on which all anatomical descriptions are based. The anatomical position allows us to reference specific body regions as related to the body as a whole (Moore 2013). It also allows us to describe the relationship of one anatomical landmark to another. For example, we can clearly describe the location of the tibial tubercle by indicating that it is anterior on the proximal tibia, just inferior to the patella. Whenever you refer to a body region or anatomical structure, you will always describe it relative to an anatomical reference position. Doing so will help you avoid confusion and misinterpretation of your findings.

Anatomical position can be described with the body either standing erect or lying **supine** (lying on the back), but it is probably easiest to visualize it as standing (figure 1.1). When the body is standing or lying supine, the head, eyes, and toes point directly forward. This is an anterior (front, or forward) position. The arms are positioned at the patient's side, with the palms facing forward, and the lower limbs are straight and together with the feet pointing anteriorly.

From the anatomical reference position, we can define three anatomical planes (figure 1.2). Anatomic

cal planes are imaginary planes that separate the body into left and right (**sagittal**), top and bottom (**transverse**), and front and back (**frontal**). At times, the sagittal plane is referred to as the **anterior–posterior plane**, and the frontal plane is referred to as the **coronal plane**. These planes of reference are useful when describing postural positions (chapter 4) and common movement patterns (chapter 6).

Table 1.1 lists terms that describe the position of body parts in reference to other parts of the body and the body itself in the anatomical reference position. The table also includes synonyms that are usually reserved for particular body regions. For example, **anterior** describes structures on or near the front of the body, while **posterior** describes structures on or near the back. The anterior surface of the hands is also commonly referred to as the palmar or ventral surface, while the posterior surface is also referred to as the dorsal aspect, or dorsum, of the hand.

PHYSICAL MATURITY CLASSIFICATIONS

Physical maturity classifications allow us to define stages of physical growth. This standard classification system describes normal anatomic and physiologic development from infancy to older adulthood. These classifications are particularly relevant to this text in understanding the maturity and strength of the musculoskeletal system, but they are also used for differentiating physiological findings where appropriate (e.g., normal vital signs for child versus adult in chapter 9). Physical maturity is defined by the following classifications:

- **Infant** (0-12 months).
- **Childhood** (1-11 years) spans infancy to the onset of puberty and is characterized by steady growth and development. The skeleton is immature with epiphyseal (growth) plates open to allow bones to elongate.



FIGURE 1.1 Anatomical position from (a) front and (b) back.

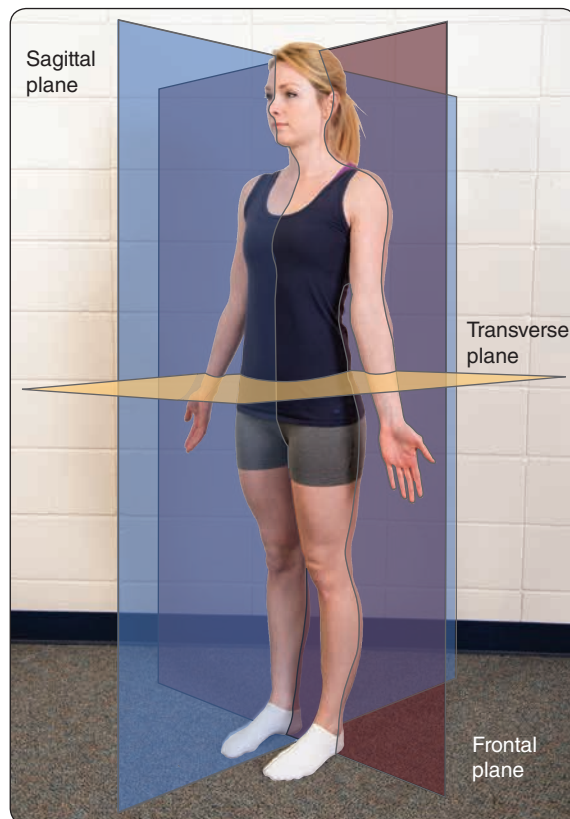


FIGURE 1.2 Anatomical planes.

**Table 1.1** Chart of Anatomical Terms

Term	Synonyms	Term defined
Anterior	Ventral Palmar	Toward the front of the body
Posterior	Dorsal	Toward the back side of the body
Superior	Cranial Cephalic	Toward the head
Inferior	Caudal	Moving away from the head toward the feet
Medial	—	Toward the midline of the body
Lateral	—	Away from the midline of the body
Proximal	—	A position or attachment on the body that is in closer proximity to the trunk or origin of reference
Distal	—	A position or attachment on the body that is farther away from the trunk or origin of reference
Superficial	—	Nearer to the surface of the skin
Deep	—	Farther from the surface of the skin
Central	—	Nearer or closer to the center of a structure or system
Peripheral	—	Farther away from the center of a structure or system
Visceral	—	The covering of an internal organ
Parietal	—	The external wall of a body cavity

Adapted from K.L. Moore, 1992, *Clinically oriented anatomy*, 3rd ed. (Baltimore: Williams & Wilkins).

The age range of 1 to 5 years is considered young childhood and 6 to 11 years, middle childhood.

- **Adolescence** (11-13 through 18-20 years) spans the onset of puberty through full skeletal maturity. The onset of puberty is marked by the development of secondary sexual characteristics (pubic hair, menarche, and increased breast development in females; deepening voice and axillary pigmentation and facial hair in males) and peak height growth and weight gain (growth spurt). Skeletal maturity is marked by full closure (ossification, the formation of bone) of the epiphyseal plates and cessation of further growth in height. The age at which different bones complete ossification differs widely, ranging from early teens to early 20s. Because growth and development vary among individuals, it's difficult to name exact age limits. Adolescence begins approximately 2 years earlier in females than in males.

- **Adulthood** (18-40 years) indicates full physical maturity and development. Young adults are those aged 18 to 40 years. In this stage, bone and muscle mass increase through 25 to 30 years of age, after which mass levels off and then slowly declines.

- **Middle adulthood** (40-60 years) is marked by a gradual decline in strength, coordination, and balance.

- **Older adulthood** (greater than 60 years) spans the rest of the human being's life. This stage is marked by accelerating decline in strength, coordination, and balance. However, this decline can be highly individual depending on lifestyle, activity, nutrition, and disease.

INJURY CLASSIFICATIONS

Injuries are classified by the structure involved and the length of time experienced symptoms are present. In some cases subclassifications describe the severity of injury. This section defines the common injury classifications and subclassifications and **cardinal signs** and **symptoms**.

Sign Versus Symptom

The terms signs and symptoms are two separate injury descriptors rather than synonyms. A **sign** refers to a finding that is observable or that can be objectively measured, such as swelling, discoloration, deformity, **crepitus**, or redness. A **symptom**, on the other hand, denotes a subjective complaint or an abnormal sensation the patient describes that cannot be directly observed. Complaints or perceptions of pain, nausea, altered sensation, and **fatigue** are symptoms that patients commonly report.

Acute Versus Chronic

Injuries are classified as either acute or chronic. **Acute** injuries are conditions that have a sudden onset and are of short duration. They typically result from a single traumatic event or mechanism. Usually, the athlete clearly knows and recalls the mechanism of injury, as the signs and symptoms associated with the injury typically begin to surface immediately.

Chronic injuries, on the other hand, usually have a gradual onset and are of prolonged duration. Many times the exact mechanism or time of injury is not known. Chronic injury usually results from an accumulation of minor insults or repetitive stresses that would not be sufficient to cause injury if the same stress or insult were applied in an isolated event. Consequently, chronic injuries are primarily inflammatory conditions in which the demands on the tissue exceed its ability to heal and recover before additional stress is applied. Common inflammatory conditions are listed in table 1.2. Chronic injury often occurs following periods of inadequate rest or recovery, overuse of a muscle or body part, repetitive overloading of a structure, or repetitive friction between two structures. As such, these injuries may also be referred to as **overuse injuries**. Chronic injuries are often more difficult to

treat than acute injuries, as the longer the pathologic state continues, the longer it takes for healing to occur and symptoms to subside.

CLOSED (UNEXPOSED) WOUNDS

Closed wounds include any injury that does not disrupt the surface of the skin. Although closed wounds are not always visually obvious, most result in noticeable signs (e.g., swelling, discoloration, and deformity) that aid in injury examination. Common examples of closed wounds include contusions, ligament sprains, muscle and tendon strains, inflammatory conditions, some bony fractures, joint dislocations, and neurovascular injuries.

Closed Soft Tissue Injuries

Closed injuries to soft tissue can occur as contusions, sprains, or strains. These types of soft tissue injuries are further classified according to the degree of severity or the extent of injury.

Contusion

A **contusion**, or bruise, refers to the compression of soft tissue by a direct blow or impact sufficient to



Table 1.2 Common Chronic Inflammatory Conditions

Condition	Description	Signs and symptoms
Apophysitis	Inflammation of a bony projection or outgrowth that serves as a muscle attachment	Pain, tenderness, swelling, increased bony prominence, pain with muscle tension
Bursitis	Inflammation or swelling of a bursa (synovial-filled membrane that lies between adjacent structures to limit friction and ease movement)	Pain, redness, heat, palpable fluid accumulation, crepitus and/or fluid thickening
Capsulitis	Inflammation of a joint capsule	Pain, localized joint inflammation and swelling, decreased range of motion
Myositis	Inflammatory response in a muscle or its surrounding connective tissue; can lead to ossification	Pain, inflammation, tenderness, decreased range of motion; possible calcium deposit
Neuritis	Inflammation or irritation of a nerve or nerve sheath	Local and referred pain, pain with percussion, tenderness, impaired sensation and motor function
Periostitis	Inflammation of the membranous lining of a bone	Pain, palpable swelling or “bumpiness” and tenderness along the bone; pain with attaching muscle action
Tendinitis	Inflammation of a tendon attaching muscle to bone	Pain, swelling, palpable tenderness and crepitus; pain with active and resistive muscle action
Tendinosis	Microscopic tearing and degeneration of tendinous tissue from repetitive trauma	Chronic pain, palpable tenderness, decreased ROM, pain with passive stretch, pain and weakness with active and resistive muscle action
Tenosynovitis	Inflammation of the synovial sheath covering a tendon	Pain with palpation and movement of the tendon within the sheath; swelling or thickening, snowball crepitus, and decreased range of motion

cause disruption or damage to the small capillaries in the tissue. This trauma will cause local bleeding or hemorrhage, resulting in **ecchymosis**, or discoloration of the tissue. There will also be localized pain and tenderness. Ecchymosis and swelling may occur immediately or may be delayed, depending on the severity of injury. The severity of a contusion can be described as **first-degree**, **second-degree**, or **third-degree**, usually according to the extent of tissue damage and functional impairment.

- **First-degree.** A first-degree contusion involves only superficial tissue damage, causing minimal swelling and localized tenderness and no limitations in strength or range of motion.

- **Second-degree.** A second-degree contusion is characterized by increased pain and hemorrhage caused by increased area and depth of tissue damage, resulting in mild to moderate limitations in range of motion, muscle function, or both.

- **Third-degree.** A third-degree contusion is a severe tissue compression, resulting in severe pain, significant hemorrhage, and **hematoma** formation, as well as severe limitations in range of motion and muscle function. With third-degree contusions, you should suspect strongly that deeper structures (e.g., bone, muscle) may also have been damaged, but that such damage may be masked by the signs and symptoms associated with superficial soft tissue damage.

Sprain

A **sprain** is an injury to a ligament or capsular structure. Because ligaments attach one bone to another, sprains are associated with joint injury. Sprains result from forces that cause two or more connecting bones to separate or go beyond their normal range of motion, subsequently stretching and tearing the attaching ligament(s) or capsule. To describe the severity or extent of injury, a sprain is further classified as first degree, second degree, or third degree.

- **First-degree.** A first-degree sprain is characterized by mild overstretching and does not cause any visual disruption in the tissue. Signs and symptoms include mild pain and tenderness over the involved ligament and little or no disability. Active and passive range of motions usually are not limited, but the athlete will typically experience pain at the end of the range as the ligament becomes taut. When the joint is stressed, the athlete will complain of pain, but you will notice a firm or definite **end feel**, without any joint **laxity**. With first-degree sprains, inflammation and discoloration

are usually minor and may be delayed until the next day. However, in some body regions, such as the lateral ankle, a relatively minor sprain can cause considerable and rapid swelling if a major capillary running adjacent to the ligament is disrupted. In other words, the degree of swelling and discoloration is not always a good indication of injury severity.

- **Second-degree.** With a second-degree injury, further stretching and partial disruption or macrotearing of the ligament occur. Second-degree injuries represent the broadest range of injury; therefore the severity of signs and symptoms and disability vary considerably. Signs and symptoms range from moderate to severe pain, point tenderness, ecchymosis, and swelling. Range of motion and normal function are usually limited secondary to pain and swelling. **Stress testing** will show varying degrees of joint **instability** (laxity), but the ligament will still be sufficiently intact to feel an end point where joint motion ceases.

- **Third-degree.** A third-degree sprain is characterized by complete disruption (rupture) or loss of ligament integrity. The athlete may have felt or heard a pop at the time of injury. Signs and symptoms include immediate pain and disability, rapid swelling, ecchymosis, and loss of function. Stress testing of the ligament will reveal moderate to severe joint instability, and there will be no firm end feel or end point to joint motion. Third-degree injuries can be initially deceiving in that range of motion and stress testing are typically less painful than with second-degree injuries, since no tension is placed on the injured structure if it is completely torn.

Strains

Whereas sprains involve stretching or tearing of a ligament, **strains** involve stretching or tearing of a muscle or tendon. Muscle and tendon strains occur most often as a result of a violent, forceful contraction or overstretching of the myotendon unit. Similar to sprains, strains are classified by severity as first-degree, second-degree, and third-degree injuries.

- **First-degree.** A first-degree strain is characterized by overstretching and microtearing of the muscle or tendon, but there is no gross fiber disruption. The athlete will complain of mild pain and tenderness but will typically have a full active and passive range of motion and little or no disability. Pain will usually accompany resisted muscle contraction. Following a first-degree strain, it is not uncommon for an athlete to continue to practice or compete, as pain and tenderness are often delayed until the next day.