**CORE STRANDS and Standards**

**Strand 3 Students will describe the injury and healing process.**

**Standard 1** Discuss the inflammatory response and the healing process

* + - Compare and contrast Acute and Chronic injuries.
    - Discuss the purpose of inflammation.
    - Categorize the stages of acute injury healing and explain the processes involved in each.
      * Acute (Inflammation) Phase
        + Signs and symptoms of inflammation

Heat

Redness

Swelling

Pain

Loss of function

* + - * + Time frame
        + Define vasodilation and explain why it occurs
        + Define hypoxia and explain its role in secondary injury
      * Subacute (Repair and Regeneration) Phase
        + Time frame
        + Explain what fibroblasts are
        + Explain what collagen is and its role in scar tissue formation
      * Remodeling (Maturation) Phase
        + Time frame
        + Define adhesions
        + Explain Wolff’s Law

**Standard 2** Compare and contrast injury classifications.

* + - Describe first degree injuries
    - Describe second degree injuries
    - Describe third degree injuries

**Standard 3** Compare and contrast common fractures.

* + - Compression
    - Depressed
    - Greenstick
    - Comminuted
    - Longitudinal
    - Spiral
    - Transverse

**Standard 4** Vocabulary:

* + - Anatomical Planes
      * Sagittal Plane/Midsagittal
      * Frontal/Coronal
      * Transverse/Horizontal
    - Signs & Symptoms
      * Acute
      * Chronic
      * Constriction
      * Dilation
      * Ecchymosis
      * Edema
      * Effusion
      * Inflammation
      * Joint Laxity

Strand 3 – INJURY AND HEALING PROCESS

Lecture Notes

**Standard 1** Discuss the inflammatory response and the healing process

1. **Introduction**
   1. Obviously, injury is a part of athletic participation
   2. At any level, athletes have to learn how to cope with an array of injuries that may temporarily interfere with their performance or may require extended time away from their sport
   3. It is vital that the sports medicine professional understands how the body heals in order to help the athlete have a full recovery and limit continued damage to body tissue
2. **Acute and Chronic Injuries**
   1. **Acute injuries**
      1. Injuries that have a sudden onset with a definite time of occurrence
      2. Generally result from a large force that overcomes the tissue being acted upon
      3. Characterized by sudden onset of symptoms that can generally be traced to a specific event
      4. Examples:
         1. Sprained ankle
         2. Torn ACL
         3. Hamstring Strain
   2. **Chronic Injuries**
      1. Injuries that occur from prolonged over-use
      2. Onset cannot be traced to one specific event
      3. Generally result from a small force that is repeated over and over for an extended period of time.
      4. Commonly associated with a biomechanical issue and may be associated with one of the following:
         1. Improper form or technique
         2. Beginning a new sport or activity that the body is not yet accustomed to
         3. Genetic components such as hyperpronation, scoliosis, muscle imbalances, etc.
      5. Examples:
         1. Achilles tendinitis
         2. Jumpers knee (patellar tendinitis)
         3. Shin Splints (Medial Tibial Stress Syndrome)
3. **Inflammation**
   1. The body’s normal response to injury
   2. It is a series of events that attempts to minimize further tissue damage by localizing the trauma and creating an environment for healing to occur
   3. The inflammatory response may progress to resolution of the injury and repair of the damaged tissue or persist as chronic inflammation
   4. While the word usually has a bad connotation, it should be noted that the process is normal, and in fact, necessary for healing to occur
      1. not all tissues respond the same and many of the inflammatory processes can cause secondary issues
      2. It is the attempt in sports medicine to limit the adverse affects and encourage the advantageous affects
4. **Stages of Healing**
   1. Acute (Inflammation) Phase
      1. This phase is marked by initial damage (primary cell death) to the affected tissues
         1. Among these tissues are blood vessels which are bringing oxygen and nutrients to the tissues
      2. Since the blood vessels are not intact, normal blood flow to cells is disrupted and tissue death occurs (secondary cell death)
         1. Cell death as a result of lack of oxygen is termed **hypoxia**
      3. This phase is characterized by a general increase in blood flow bringing blood cells and chemicals that clean up cellular debris and initiate healing
      4. During this phase the **signs of inflammation** are readily apparent:
         1. Pain (which occurs due to 2 mechanisms)
            1. Pain receptors in the area are triggered by initial trauma
            2. Also occurs from chemicals that are released into the area
            3. Together these sources tell the body that damage has occurred and encourages decreased activity so healing can take place.
            4. It should be noted that this decreased activity is important for proper healing and that pain medication can actually hinder this process
         2. Swelling (which occurs due to 4 mechanisms)
            1. Initial trauma causes blood vessels to rupture

This causes blood to leak out of blood vessels into the extracellular compartment

* + - * 1. Damaged cells fail to retain intracellular fluid

This fluid is lost to the extracellular compartment

* + - * 1. Increased proteins (from cellular debris) in the extracellular fluid raises the osmotic pressure which draws more fluid out of cells
        2. Blood vessels vasodilate causing small vessels to become porous

This leads to further loss of fluid from blood vessels

* + - * 1. This swelling can increase secondary cell death due to hypoxia

A compression wrap can decrease these mechanisms and limit swelling

Controlled motion can also limit swelling and encourage extracellular drainage and venous return through the skeletal muscle pump

* + - 1. Heat
         1. This occurs because blood vessels in the area are stimulated to dilate
         2. This vasodilatation causes an increase in circulation which brings white blood cell such as macrophages and neutrophils into the area to engulf cellular debris and prepare the area for healing to begin
      2. Redness
         1. Also caused by increased blood flow since heat is carried in the blood
      3. Loss of Function
         1. A result of initial damage to supportive structures and also due to pain
         2. It should be noted that this is not necessarily a complete loss of function
    1. This phase usually last from onset to **48 to72 hours**
  1. **Subacute (Repair and Regeneration) Phase**
     1. This phase is characterized by the initiation of mechanisms with which damaged tissues can be regenerated
     2. Once cellular debris has been removed, the next step is to regain adequate blood flow
        1. This occurs through the formation of capillary buds which connect to existing vessels
     3. Once blood flow has been normalized regeneration of damaged tissues can begin
     4. However, the body’s ability to regenerate various tissues is limited
        1. Almost all damaged body tissue is repaired with “scar tissue”
        2. Scar tissue is largely composed of a protein called **collagen**
     5. During this phase specialized cells migrate into the area to begin the process of regeneration
        1. These cells are called **fibroblasts** and they are responsible for collagen production
     6. Collagen is extremely strong and also has some elastic properties
        1. Although this tissue is not the same as the existing tissues it is effective in regaining the normal abilities of the tissue provided the damage is not overly extensive
           1. This occurs for all damaged tissue in the body with the exception of bone which heals with actual bone tissue
     7. This phase usually **lasts 3 to 4 weeks**
  2. **Remodeling (Maturation) Phase**
     1. During this phase activity of fibroblasts is decreased as collagen fibers strengthen and attempt to align with existing fibers
        1. “Controlled motion” during this phase can assist in this process
        2. This type of “rehabilitation” may also help prevent the formation of **adhesions** which can form as collagen fibers contract in an effort to strengthen
           1. Adhesions are areas of overgrowth of scar tissue that have become excessively tight
           2. An area that is completely immobilized during this phase may be well healed but poorly adapted functionally because collagen fibers are deposited randomly rather than in line with existing fibers

This concept of controlled motion is best represented by a physiological process known as “**Wolff’s Law**”

This law states that “tissues grow according to the stresses placed upon them”

The law explains that in order for tissue to develop properly there must be “stimulus” for adaptation to occur

The opposite is also true – if a stimulus is removed for a prolonged period of time, tissue is removed and becomes weaker

This explains why an arm that has been casted is smaller when the immobilization is removed

* + 1. This phase overlaps the Subacute phase and may **continue for up to 1 year**

**Standard 2** Compare and contrast injury classifications.

1. **Injury Classifications**
   1. **Injuries to ligaments (sprains), and muscle or tendons (strains) are commonly categorized into 3 classifications:**
      1. **First Degree (Grade 1)**
         1. Results when the tissues have been overly stretched
         2. This commonly results in “micro-tears” in the tissue that may not be apparent at a macroscopic level
         3. Symptoms include:
            1. Pain
            2. Minor swelling
            3. Loss of function that may or may not limit activity
            4. Integrity of the fibers is generally maintained
      2. **Second Degree (Grade 2)**
         1. Results when the tissue is partially torn
         2. Moderate pain
         3. Moderate Swelling
         4. Loss of function that usually limits activity
         5. May result is some ecchymosis
         6. Integrity of the fibers is affected with joint laxity or decreased strength
      3. **Third Degree (Grade 3)**
         1. A complete rupture of the tissue
         2. Severe Pain
         3. Moderate to severe swelling
         4. Probable ecchymosis
         5. Complete loss of integrity of the joint or complete loss of function

**Standard 3** Compare and contrast common fractures

1. **Common Fractures**
   1. Compression- axial loading causes a bone to collapse
   2. Depressed- a direct force causes the bone to dip inwards on itself
   3. Greenstick- bending of a bone causes fractures on only one side
   4. Comminuted- fractured into multiple pieces; shattered
   5. Longitudinal- Vertical fracture going up the length of the bone
   6. Spiral- twisting of a bone causes a fracture which wraps around the bone
   7. Transverse- Horizontal fracture across the width of the bone