Physical Therapy: An at Home Program for the Upper Body

An Honors Thesis (HONRS 499)

by

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Author’s Statement

As an Exercise Science major, I know the extreme importance of physical activity, as well as the toll it takes on the body. Proper rehabilitation is crucial to regaining full strength and performance optimization after an injury occurrence. Do not think, however, that one must be participating in a sport in order to become injured. Everyone sustains injuries, whether it comes from falling down the stairs, throwing a baseball pitch, getting hit, or simply twisting in the wrong direction. I chose to design this simple guide of rehabilitative techniques for the general population, because most people do not understand exactly how their body is designed nor how it functions.

This guide contains common range of motion, stretching, and strengthening exercises used by physical therapists. Therefore, it is designed to be incorporated strictly after the individual has been examined by a physical therapist or health-care professional. This guide is in no way intended to assist individuals in diagnosing themselves. As a young athlete myself, I have incurred a few musculoskeletal injuries of my own, and as a result have been to the physical therapist a number of times. Often times the physical therapist will prescribe various exercises for the injured individual to do at home in order to speed up the healing process. However, I always found it difficult to remember these certain stretches and exercises once I was on my own. Therefore, I wanted to create a guide to help those going through the rehabilitation process achieve the most from their recovery by providing pictures and simple explanations of common rehabilitative techniques used by those in the sports medicine field. Thereby providing the means for those lacking professional knowledge of exercise physiology to heal quickly and correctly, while understanding what is happening to their body at the same time. Healing properly is essential to keeping the body strong. In most cases, patients who are compliant with their home exercise program will heal faster and with a lower rate of injury re-occurrence than
those who do not.

It is my goal to assist the general population in understanding rehabilitation to include at-home stretches and exercises, thus optimizing the healing process. By using this guide, the injured individual will be able to maximize their own recovery. I think it is very important for everyone to understand their body, how it is designed, and how each person can establish total body strength and flexibility by keeping their joints strong and limber.
Abstract

With today’s advancement of knowledge in the field of sports medicine, exercise is on the rise. Americans are attempting to become healthier, leaner, and in all-around better shape. Due to this increasing phenomenon, almost everyone considers themselves an “athlete” of sorts. It is no longer only those on varsity teams who exhaust their bodies in a pursuit of physical fitness, improved health, and well-being. Because of this newfound rise in amateur work-outs, there is a consequential rise in injuries as well. Extreme stresses are placed on the body as a direct result of exercise, ranging anywhere from over-use to direct trauma. Regardless of the stress, the body needs the correct rehabilitation in order to heal properly, allowing the individual to return to their full performance. Physical therapy is an important way to allow the body to heal properly. It is crucial for each individual to understand his/her body and how to regain any lost movement or strength due to injury. This guide focuses on the upper body, mainly because it is not as widely talked about due to the immense number of injuries incurred by the lower body as a result of running activities. Explanations of basic anatomy of the bones, muscles, tendons, and ligaments that make up each upper body joint are included, as well as common injuries and rehabilitative techniques, including stretching and strengthening exercises.
Basic Injury Information: Explanations of Simple Terms

LIGAMENT SPRAIN:

A sprain occurs when a ligament stretches or tears. A ligament connects two bones at a joint. Generally, a ligament becomes sprained when stress is applied to a joint that forces that joint to move beyond its normal limits. There are three grades of sprains, depending on the severity (Borowski 2008). Grade 1 is the most mild ligament sprain and involves some stretching or perhaps microtearing of the ligamentous fibers. There is little or no joint instability with this degree of injury and symptoms include mild pain, slight swelling, and mild joint stiffness (Malliaropoulos 2006). A grade 2 sprain involves increased tearing and separation of the ligamentous fibers and moderate instability of the joint. There is moderate to severe pain, swelling, and joint stiffness. Grade 3 is the most severe sprain and involves a complete tear of the ligament. This injury presents primarily with gross instability of the joint (Abel 1985).

FRACTURE:

Since there are many different forces applied to bone, there are many different resulting bone fractures. Among these different fractures, any can be open or closed, complete or incomplete. A closed fracture does not break the skin. In an open fracture, the fractured ends of the bone actually break through the skin. Fractures are complete when the bone is broken into at least two fragments and incomplete when the fracture does not extend completely across the bone (Van De Graaff 2002).

Most fracture names refer to how the fracture presents itself in the bone, others, however, refer to the mechanism of the injury. A transverse fracture, for example, is a crack horizontally across the shaft of the bone and goes completely through the bone. A linear fracture
runs parallel to the long axis of the bone. A spiral fracture runs diagonally across the bone and involves an element of twisting or rotation which causes the fracture to spiral along the longitudinal axis of the bone. An oblique fracture is also a diagonal crack across the bone with two very jagged, pointed ends that, if displaced, can potentially cause soft-tissue damage (Vestergaard 2009). An avulsion fracture occurs when a fragment of the bone is pulled away at the bony attachment of a tendon or ligament. An impacted fracture is when one end of the fractured bone is driven up into the other end. Comminuted fractures can be a serious problem because there are multiple fragments of the bone, similar to an explosion, which generally require surgical repair with screws and wires (Iwamoto 2009). Greenstick fractures occur in children whose bones have not yet calcified and hardened, so the bone actually splinters. Stress fractures are the most common fracture, resulting from physical activity. They are an overuse injury and are caused by repetitive forces transmitted through the bone which then produces irritations and microfractures at a specific area in that bone (Abel 1985).

MUSCLE STRAIN:

Muscle strains occur when a musculotendinous unit is overstretched or forced to contract against too much resistance, thus exceeding the extensibility limits or the tensile capabilities of the weakest part of the unit causing damage to the muscle fibers or tendons (Manning 2008). Just as there are different degrees of ligament sprains, muscle strains can be classified according to their severity. A grade 1 muscle strain involves some muscle or tendon fibers that have been stretched or torn. Pain and tenderness are only present with active movement and full range-of-motion is still possible. Grade 2 is considered a moderate strain and involves partial tearing of muscle or tendon. Active contraction produces extreme pain and there is usually a palpable
depression in the muscle where the fibers have been torn. Some swelling may occur. A grade 3 muscle strain is the most severe. The muscle becomes completely torn, usually where the muscle and tendon meet, resulting in significant impairment or total loss of movement (Ohashi 2008).

TENDINITIS:

Of all the overuse injuries associated with physical activity, tendinitis is the most common. The term tendinitis describes many different pathological conditions of a tendon. Essentially, it is any inflammatory response within the tendon. During muscular contraction, a tendon must move or slide over the structures around it (Xu 2008). If a particular movement is done repeatedly, the tendon can become irritated or inflamed. This inflammation is manifested by pain on movement, swelling, possibly some warmth, and crepitus (Omoigui 2007).

TENOSYNOVITIS:

Tenosynovitis is similar to tendinitis in that the muscle tendons are inflamed (Ilayer 2007). Many tendons are subject to an increased amount of friction due to the tightness of the space through which they must move. In these areas of high friction, tendons are usually surrounded by synovial sheaths that reduce the friction of movement (Tehrandzadeh 2006). If the tendon sliding through a synovial sheath is subjected to overuse, inflammation is likely to occur. The inflammatory process produces by-products that are "sticky" and tend to cause the sliding tendons to adhere to the synovial sheath surrounding it, resulting in tenosynovitis, or inflammation of the tendon sheath (Omoigui 2007).
BURSITIS:

During muscular contraction, there is a high amount of movement within the joint complex. Ligaments, tendons, muscles, and bones all move around one another, creating friction. Most joint complexes contain bursae to help decrease the friction placed on the surrounding tissues. Bursae are essentially pieces of synovial membrane that contain small amounts of synovial fluid. This synovium lubricates the area, thereby permitting motion of surrounding structures without friction (Colas 2004). If, however, excessive movement or acute trauma occurs around these bursae, they can become irritated and inflamed and begin producing large amounts of synovial fluid (Omoigui 2007). As the fluid continues to accumulate in the limited space, pressure increases and causes irritation and pain. Bursitis can be extremely painful and can severely restrict movement, especially when it occurs around a joint. Synovial fluid continues to be produced until the movement or trauma producing the irritation is eliminated (“Bursitis” 2002).
Chapter 1: Shoulder
Anatomy

The shoulder is made up of three bones: the clavicle (collarbone), humerus (upper arm bone), and scapula (shoulder blade). The articulations between the bones make up the shoulder joints. An articulation is when two bones come together, forming a joint and allowing movement (Van De Graaff 2002). The shoulder consists of several joints so that it can create a complex series of movements between the arm and trunk. Each joint cavity is cushioned by articular cartilage which covers the ends of the bones (Lippert 2006).

There are three joints that comprise the shoulder joint cavity. The first is the glenohumeral joint. This is the main joint of the shoulder and is generically referred to as the “shoulder joint”. This joint is formed by the end of the scapula, called the glenoid, and the head of the humerus. It is a ball and socket joint, allowing the arms to rotate circularly or hinge out and up away from the body. The “ball” part of the joint is the rounded, medial front surface of the humerus and the “socket” is the cupped groove of the lateral scapula (glenoid). There are three ligaments, called glenohumeral ligaments, that attach the humerus to the scapula (Lugo 2008). Second is the acromioclavicular (AC) joint. As the name signifies, it is located between the acromion process of the scapula and the distal end of the clavicle. The capsule of this joint is reinforced by the coracoclavicular ligament which connects the coracoids process to the clavicle. Another ligament, the coracoacromial ligament, runs from the coracoid process to the acromion process and the acromioclavicular ligament, adding strength to the AC joint (Lugo 2008). Last is the sternoclavicular joint. This joint is at the medial end of the clavicle and the sternum. The main stabilizer of this joint is the costoclavicular ligament, which prevents almost all movement. There is, however, a disc present at the joint that increases the range of movement ever so slightly (Lippert 2006).
This complex of joints allow it to move through an incredible range of motion, making it the most flexible and mobile joint in the human body. The shoulder can adduct, abduct, rotate, flex, extend, and circumduct (Lippert 2006)!

The scapula is a large, flat, triangular-shaped bone located on each side of the upper back. It has connections with the clavicle, humerus, and ribcage and is firmly attached to the back by strong muscles. There are four main structures, or prominences, on the scapula that serve as key attachment points for ligaments and muscles (Van De Graaff 2002). The scapula extends up and around the shoulder joint at the back to form the acromion process (the highest point of the shoulder), and around the shoulder joint at the front to form the coracoid process. The tendons in the shoulder help join the bones to surrounding muscles, creating a complex network for movement. For example, the biceps tendon attaches the biceps muscle to the glenoid and helps to stabilize the joint (Lugo 2008). Because there is limited bone support in this shallow joint, the importance of soft tissues such as muscles, tendons, ligaments, and cartilage cannot be overstated. These structures are essential in that they add a great deal of joint stability and support. There are four short muscles which originate on the scapula and pass around the shoulder where their tendons together form the rotator cuff. This series of muscles is the most important stabilizer in the shoulder joint and allows the shoulder to be rotated both inward (internal rotation) and outward (external rotation) (Lippert 2006). The rotator cuff is comprised of the supraspinatus, infraspinatus, teres minor, and subscapularis muscles, known as the SITS muscles for short. These muscles all insert at the top of the humerus (Torg 1987).
**Common Injuries**

**IMPARINGMENT SYNDROME:**

Impingement syndrome often occurs in the shoulder joint due to the lack of space between the humeral head and the acromioclavicular joint. Numerous muscles and tendons run through this space and can be crushed. This type of injury develops specifically when there is an impairment of the subacromial space under the coracoacromial arch. When the stabilizers of the shoulder, such as the supraspinatus and biceps tendons, fail to maintain this space, the soft-tissues become compressed. This repetitive compression leads to irritation and inflammation, which then progresses to fibrosis, and eventually results in a rupture of the supraspinatus (Prentice 2004). When the structures within this acromial arch become swollen or inflamed, there is a consequential decrease in the space under the arch, impinging further upon the tissues. Impingement syndrome can also be caused when the space available for the supraspinatus decreases due to the presence of osteophytes (small, abnormal bony outgrowths) on the acromion (Tonino 2009). There are two types of impingement: outlet and nonoutlet. Outlet, also known as outside, impingement occurs when the rotator cuff comes in contact with either the coracoacromial ligament or the acromion itself. When this happens, there is fraying, tearing, inflammation, fibrosis, and degeneration on the top surface of the cuff. The older population is more likely to exhibit this type of impingement. Nonoutlet, also known as inside, impingement is more likely to occur in younger athletes. The subacromial space may appear normal, but when the arm is forced up while rotating inward, the rotator cuff becomes impinged on the back top of the glenoid labrum and the humeral head. This impingement potentially causes inflammation on
the underside of the rotator cuff tendon, tears to the back top of the glenoid labrum, and lesions on the back of the humeral head (Robinson P. 2008).

STERNOCLAVICULAR SPRAINS AND DISLOCATIONS:

When the sternoclavicular joint becomes injured, an inflammatory process immediately occurs. This can cause joint stiffness due to the collagen tissue being produced for healing (Prentice 2004). Sprains are defined by the level or degree of injury. A first-degree (mild) sprain involves stretching of the costoclavicular ligament, but usually does not cause any instability. A second-degree (moderate) sprain of the sternoclavicular and costoclavicular ligaments, on the other hand, results in a looseness and instability of the joint. A third-degree (severe) sprain, which involves dislocation or subluxation, occurs when both ligaments are severed (Robinson CM 2008).

This joint can become dislocated forwards or backwards. Anterior (forward) dislocation occurs when the medial end of the clavicle is displaced and pops either up or forward. It is characterized by swelling, grating, clicking, and popping (MacDonald 2008). Posterior (backward) dislocation of the clavicle can be life-threatening because the clavicle could potentially impinge on the nerves of the neck. Symptoms include a snorting type of breathing, dysphagia (difficulty swallowing), and neurovascular problems (Hoekzema 2008).

ACROMIOCLAVICULAR SPRAIN:

The acromioclavicular joint usually becomes sprained when there is a blow against the outer end of the shoulder. This force will drive the acromion and the clavicle apart. Sprains of
this joint are commonly referred to as “shoulder separations”. Slight stretching of the acromioclavicular or coracoclavicular ligaments are considered grade 1 separations. Grade 2 separations usually involve a complete tear of the acromioclavicular ligament and a partial tear to the coracoclavicular ligament. Symptoms include swelling, a notable prominence at the joint, a moveable clavicle at the distal end (farthest from the body), pain with any active overhead movement, and tenderness at the joint. Grade 3 separations are the most severe and involve a complete tearing of three of the acromioclavicular and coracoclavicular ligaments. There is more swelling and tenderness than in the other two types, pain with movement, and an upward tilt of the outer end of the clavicle. Grades 4-6 involve complete tearing and dislocation and must be repaired surgically (MacDonald 2008).

GLENOHUMERAL SUBLUXATION AND DISLOCATION:

Subluxation can occur when there is any sort of disruption of the glenohumeral ligaments, the labrum (cartilaginous ring around the edge of the glenoid, making the cavity deeper), and/or the glenoid itself (Lippert 2006). With subluxation, the head of the humerus moves partly out of the glenoid cavity but not completely. Dislocations, however, occur when the humerus becomes completely displaced from its usual position in the glenoid. With anterior dislocation, the head of the humerus comes out forward out of the shoulder joint capsule and then often descends downward to rest under the coracoid process. This type of dislocation results from direct impact to the back of the shoulder and/or forced abduction, external rotation, or extension. Posterior dislocations occur from the opposite direction, with forced adduction and internal rotation of the shoulder or falling on an extended, internally rotated arm. Glenohumeral dislocations tend to result in torn ligaments and capsular tissues, as well as a possible tearing away of the tendons of
the rotator cuff muscles (Braun 2009). Symptoms include: feeling of slipping with overhead activity, muscle spasm, and pain on abduction/external rotation. Some authors claim that posterior dislocations are subluxations that develop over time. There is a high recurrence rate for dislocations in individuals younger than 40 years old (Torg 1987).

CLAVICLE FRACTURES:

A clavicle fractures when the individual sustains a direct blow to the front of the shoulder, or falls on the shoulder or an outstretched arm. Symptoms include: drooping shoulder, tenderness, a palpable deformity, pain, and crepitus with movement. (Torg 1987)

ROTATOR CUFF TEARS AND TENDONITIS:

Because the rotator cuff surrounds most of the shoulder joint capsule, these muscles can become torn by different mechanisms. Subluxation/dislocation of the glenohumeral joint, fractures to the greater tuberosity, or degeneration of cuff tissue can all cause rotator cuff tears. These tears, as well as tendonitis, can also result from compression of the cuff tissues, tensile overload (repeatedly generating high forces by contracting muscles), or a traumatic event such as falling on an outstretched arm (Yadav 2009). Rotator cuff tears are divided into two separate categories: partial and complete. While partial tears are more common, both result in pain, cuff tenderness, limited range of motion, and difficulty abducting and externally rotating (Scibek 2009). Rotator cuff tendinitis is sharp, localized, and severe. Symptoms include: decreased shoulder function, localized tenderness, and discomfort when stretching the affected tendon (Torg 1987).
ADHESIVE CAPSULITIS (FROZEN SHOULDER):

Adhesive capsulitis, also known as frozen shoulder, generally occurs when a problem goes untreated and the shoulder becomes immovable ("frozen"). This problem generally begins with limited abduction and external rotation. These two actions start causing increasing soreness that develops into constant pain and disability. It is at this point that the shoulder becomes immovable and can be characterized by inflammation and swelling at the glenohumeral joint (Tasto 2007). Adhesive capsulitis is considered either primary or secondary, depending on the mechanism of development. When it develops spontaneously it is said to be primary, a very rare condition to see in the athletic population. It is considered secondary when a known underlying condition is present. These underlying diagnoses fall into eight categories of conditions: trauma, soft-tissue disorders about the shoulder, joint disorders, bone disorders, cervical spine disorders, intrathoracic disorders, abdominal disorders, surgery, and psychogenic disorders (Milgrom 2008).

BICEPS TENDON RUPTURES:

The biceps tendon attaches to the shoulder on top of the glenoid, making it very vulnerable to injury since it travels around the humeral head and through the shoulder to its attachment point (Lippert 2006). Bicep tendon ruptures can occur in four different locations: where the tendon originates in the aforementioned glenoid fossa, in the bicipital groove, at the musculotendinous junction in the upper arm, or at the insertion on the ulna. When the biceps tendon ruptures, the bicep muscle bulges and there is a clearly palpable defect. Pain may be intense after an acute rupture, or mild, recurrent and accompanied by stiffness (Rineer 2009).
BURSITIS:

Bursitis of the shoulder joint is characterized by pain below the acromion process, and is caused by abduction and external rotation. This injury involves the musculotendinous rotator cuff and the biceps tendon, not just the bursa like the name implies. The pain associated with this injury is caused by impingement of the inflamed structure (“Bursitis” 2002).

SWIMMER’S SHOULDER:

Swimmer’s shoulder is caused by both impingement and overuse. The syndrome progresses into four phases if not treated. First, there is pain only after activity. Next, the pain occurs both during and after activity, but participation is still possible. Third, pain begins to interfere with normal athletic activity. And last, there is pain during the normal course of the day (Weldon 2001). Typically, tenderness is present along the coracoacromial ligament and under the acromion. Pain can also occur in the scapular region and the trapezius muscle due to fatigue (Robinson P. 2008).
Rehabilitation

RANGE OF MOTION/ STRETCHING EXERCISES

Codman Exercise:
Bend forward at the waist and hold onto a chair or table with the uninjured arm for support. Swing the injured arm from side to side, back and forth, and in a circle for two minutes (Fig 1-1A) (Fig 1-1B)

![Fig 1-1A](image)

![Fig 1-1B](image)

Wall Climbs (abduction):
Stand perpendicular to a wall, with the side of the injured arm against the wall. Use the fingers of the injured arm to "walk" the hand up a wall (Fig 1-2)

Wall Climbs (flexion):
Stand facing a wall. Use the fingers of the injured arm to "walk" the hand up the wall (Fig 1-3)

![Fig 1-2](image)

![Fig 1-3](image)
Shoulder Extension:
   Hold a wand/stick on the side of the body with the injured arm. Place the hand of the injured arm on the end of the wand and use the other hand to push the wand back as far as possible, extending the injured arm (Fig 1-4)

![Fig 1-4](image)

Inferior Capsule Stretch:
   Gently pull the arm back behind the head and push down on the elbow. Hold this stretched position (Fig. 1-5)

![Fig 1-5](image)

Horizontal Adductor Stretch:
   With the elbow flexed approximately 60 degrees, bring the arm around the chest horizontally and push with the opposite hand. Hold this stretched position (Fig. 1-6)
Overhead Stretch:
   Extend the arms overhead as far as possible until a stretch is felt. Hold this stretched position (Fig 1-7)

Internal Rotator Stretch:
   Hold a stick behind the back and pull downward with the left hand until a stretch is felt in the right shoulder. Repeat this exercise for the opposite shoulder (Fig 1-8)

External Rotator Stretch:
   Hold a stick behind the back and pull up on the stick with the right hand until you feel a stretch in the left shoulder. Repeat on the opposite side for the right shoulder (Fig 1-9)
Horizontal Abductor Stretch:
   Extend both arms back behind the body and push together (Fig 1-10)

Wall/Corners Stretch:
   Stand facing a corner, place one hand on each wall, and lean forward (as if doing a standing push-up) until there is a stretch in the shoulders (Fig 1-11)
STRENGTHENING EXERCISES

Shoulder External Rotation:
Using tubing or a theraband, keep elbow in at side (Fig 1-12A), rotate arm outward away from body. Keep forearm parallel to the floor (Fig 1-12B). Bring arm back in and repeat.

Shoulder Internal Rotation:
Using tubing or a theraband, keep elbow in at side (Fig 1-13A), rotate arm inward across the body. Be sure to keep forearm parallel to the floor (Fig 1-13B). Bring arm back out and repeat.
Shoulder Abduction:
Stand holding tubing or a theraband with the injured arm. Start with arm at side (Fig 1-14A) and pull up and away until arm is parallel to the floor (Fig 1-14B). Bring arm back in and repeat.

Shoulder Adduction:
Stand holding tubing or a theraband with the injured arm. Start with the arm away from the body (Fig 1-15A) and pull arm in toward hip, making sure not to twist or rotate the trunk (Fig 1-15B). Bring arm back out and repeat.
Shoulder Flexion:
Using tubing or a theraband, start with arm at side (Fig 1-16A) and pull forward and upward (Fig 1-16B). Lower and repeat.

Shoulder Extension:
Using tubing or a theraband, start with arm at side (as above) and pull arm up and back (Fig 1-17). Be sure to keep elbow straight. Bring arm back forward and repeat.
Push-Up Plus:

Lie flat on back with arms extended towards ceiling (Fig 1-18A). Attempt to push arms straight up towards ceiling while keeping the back against the floor and the elbows straight (Fig 1-18B)
Chapter 2: Elbow

Elbow joint bone anatomy

Muscles of the elbow
Anatomy

The elbow joint is comprised of three different bones: the humerus (upper arm), the radius (thumb side of the forearm), and the ulna (pinky side of the forearm). The elbow is considered a hinge joint because it functions/moves much like that of an actual hinge, flexing (bending) and extending (straightening). The ulna and the humerus are what articulate with one another to create this flexing and extending motion. The radius and ulna also articulate with one another, allowing for movements of the forearm such as pronation (palm down) and supination (palm up) (Van De Graaff 2002).

There are two main ligaments in the elbow joint. They run between the humerus and the ulna, essentially helping prevent movement of the elbow from side to side. The first is called the ulnar-collateral ligament and it is located on the inside of the elbow. The second is the radial-collateral ligament, found on the outside of the elbow (Lippert 2006). Tendons are also present in the joint, connecting these bones to various arm muscles. Different muscles are needed for each activity the elbow joint performs. In order to flex the elbow, the strong biceps, brachialis, and brachioradialis muscles must contract. Extension of the elbow involves the triceps brachii. Other muscles that originate at the elbow actually help to move the forearm, wrist, and hand. These muscles attach via tendons to the medial and lateral epicondyles (where the upper arm bone connects to the elbow on either side) (Van De Graaff 2002). The forearm muscles that attach to the medial epicondyle help to flex the wrist and hand. Whereas the forearm muscles that attach to the lateral epicondyle help to extend the wrist and hand. There are also muscles located deep within the elbow that assist in pronation and supination, such as the pronator teres, pronator quadrates, and supinator muscles (Lippert 2006).
Common Injuries

ELBOW MUSCLE STRAIN:

Overuse and repetitive strains are the most common sources of injury to the muscles and tendons about the elbow. Any of the muscle-tendon units of the elbow is subject to strain, such as the biceps and triceps tendons, as well as the wrist flexor and extensor tendons (Groppel 1986). The triceps tendon generally becomes strained at its attachment on the olecranon and is characterized by tenderness and pain on forced extension and passive flexion. The biceps tendon becomes strained at its attachment about the elbow joint just below the neck of the radius. Throwing activities generally develop strains of the tendons within the flexor and pronator muscle groups (Weisner 1994).

LATERAL EPICONDYLITIS (TENNIS ELBOW):

Tennis elbow, also known as lateral epicondylitis, is a degeneration or inflammation of the tendons along the outside of the elbow. More specifically, this condition involves the tendons that are responsible for anchoring the muscles that extend or lift the wrist and hand, known as wrist extensors. These tendon fibers attach to the bony prominence (epicondyle) on the outside of the elbow. Chronic overuse leads to this tendon degeneration (Souza 1997). This injury is often times referred to as “tennis elbow” because individuals encountering this problem are usually involved in activities that require repetitive and vigorous use of the forearm, such as hitting a tennis ball. Torg notes that symptoms include tenderness, pain with gripping, and limited wrist flexion. Also, if the muscle becomes strained or torn at the tendinous junction pain of the extensor carpi radialis brevis muscle is likely and injury can be worsened by forceful
contraction of the wrist extensors (1987). In some cases, the patient will feel a burning pain on
the outside of the elbow or feel the pain radiate down to their forearm (Rineer 2009).

MEDIAL EPICONDYLITIS (GOLFER'S ELBOW):

Medial epicondylitis is also commonly referred to as “golfer’s elbow” because the arm
action generally used in swinging a golf club is what stresses these tendons, leading to this
injury. Just as lateral epicondylitis affects the wrist extensors, medial epicondylitis is an overuse
tendonitis of the wrist flexors (Souza 1997). Medial epicondylitis primarily affects the flexor-
pronator muscles (ie pronator teres, palmaris longus, flexor carpi radialis). This injury is caused
by chronic strain and overuse. Overexertion of these muscles and tendons, along with
degenerative changes of the connective tissue is thought to be a major contributing factor to this
injury. Isometric contraction of the forearm is also thought to play a role. The tendonitis, then,
is primarily the result of failure of the damaged tendon to heal (Rineer 2009).
Rehabilitation

RANGE OF MOTION/ STRETCHING EXERCISES

Elbow Flexion:
   Flex the elbow as far as possible while resisting (pushing down) with the opposite hand for ten seconds. Relax and then repeat (Fig 2-1)

Elbow Extension:
   Extend the elbow as far as possible while resisting (pushing up) with the opposite hand for ten seconds. Relax and then repeat (Fig 2-2)

Wrist Flexor:
   Place the palms of the hands together and push while raising the elbows upward. Hold this stretched position (Fig. 2-3)

Wrist Extensor:
   Place the backs of the hands together and push while lowering the elbows towards the floor. Hold this stretched position (Fig. 2-4)
Forearm Flexor:
Fully extend the elbow and with the opposite hand, pull the fingers and wrist towards the body into a fully flexed position. Hold this stretched position (Fig. 2-5)

Forearm Extensor:
Fully extend the elbow and with the opposite hand, pull the fingers and wrist down into a fully extended position. Hold this stretched position (Fig. 2-6)

**STRENGTHENING EXERCISES**

Elbow Flexion (Biceps Curls):
Stand with the arms extended by the sides, grasp a dumbbell in each hand, and slowly flex the arm, lifting the weight up to the fully flexed position (Fig 2-7). Be sure to keep the elbow and upper arm close to the body. Hold this flexed position for 2 seconds, then slowly lower back to extension and repeat.
Elbow Extension (Kickbacks):
Stand with one leg on the ground and kneel with the opposite leg and hand on a bench. Begin with your arm bent at 90 degrees (Fig 2-8A) and then straighten the elbow by “kicking back” the arm (Fig 2-8B).

* See wrist strengthening section for additional exercises
Chapter 3:
Wrist and Hand

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Anatomy

The anatomy of the wrist joint is extremely complex because it is actually a collection of many bones and joints. There are 27 bones from the end of the forearm to the fingertips, the wrist itself contains eight. These small wrist bones are called carpal bones. The hand bones closest to the wrist are called metacarpals, and the finger bones are called phalanges. There are distal, middle, and proximal phalanges, each with a separating joint to allow finger movement (Moran 1989). The carpal bones are grouped into two rows, proximal and distal. The proximal row is closest to the body. These bones goes as follows, beginning with the thumb-side of the wrist: scaphoid, lunate, and triquetrum. The distal row is closer to the fingers and contains the trapezium, trapezoid, capitate, hamate, an pisiform bones (Van De Graaff 2002).

There are two important ligaments that support the sides of the wrist and connect from the forearm to the wrist, they are called collateral ligaments. The ulnar collateral ligament (UCL) runs along the pinky side of the wrist, starting at the ulnar styloid (the small bump on the edge of the wrist) where the ulna bone meets the wrist joint. This ligament is cord-shaped and so contains two parts. One part connects to the pisiform (one of the carpal bones) and to another ligament, called the transverse carpal ligament. The other goes to the triquetrum (another carpal bone). This ligament essentially keeps the wrist from bending too far to the thumb side. The other main ligament of the wrist is the radial collateral ligament (RCL) and is located on the thumb side of the wrist. It starts on the outer edge of the radius bone on the radial styloid (the small bump on the thumb-side edge of the wrist). It connects to the scaphoid (carpal bone below the thumb) and prevents the wrist from bending too far to the pinky side (Lippert 2006).

Because there are so many joints in the wrist, there are ligaments that have to attach each carpal bone to the others, as well as to the arm and finger bones, resulting in a plethora of small
ligaments! The fingers each contain two types of tendons: an extensor tendon on top, which straightens the finger, and a flexor tendon on bottom, which bends it (Moran 1989).
Common Injuries

Note many wrist and finger sprains and dislocations require only immobilization and so are not discussed in this guide.

DE QUERVAIN’S DISEASE:

De Quervain’s Disease is tenosynovitis of the wrist. It is a common condition in which the tendons around the thumb side of the wrist, those of the extensor pollis brevis and abductor pollis longus, become inflamed. Tenosynovitis is, more specifically, inflammation of the tenosynovium, which is a thin layer of tissue that produces fluid used to lubricate. This condition is generally caused by highly repetitive movements of the wrist and thumb or a blow to the thumb side of the wrist (Paynter 2006). Overuse of the wrist and thumb causes swelling of the long abductor and short extensor tendons as they pass through the same sheath of the compartment. Symptoms include pain and swelling over the styloid of the radius (thumb side of wrist), occasional development of a cyst, and in severe cases, catching and snapping with thumb movements or numbness on the back of the thumb and index finger (Chin 2002).

CARPAL TUNNEL SYNDROME:

Carpal Tunnel Syndrome is, simply, compression of the median nerve within the carpal tunnel around the wrist. The carpal tunnel itself is an incasing which wraps around all the tendons to the fingers. If these tendons become inflamed, the space within the carpal tunnel is decreased causing the nerve to become entrapped and, consequently, compressed (Prentice 2004). This syndrome is thought to be initiated by direct trauma or by the intrusion of a mass into the tunnel area. Most commonly, however, carpal tunnel syndrome occurs as a result of overuse from any sort of repetitive wrist motion. Acute carpal tunnel can occur following a
Fracture by either swelling or a fracture fragment pressing on the median nerve. Also, illnesses or injuries such as tenosynovitis from overuse or from rheumatoid arthritis have been associated with carpal tunnel (McCabe 2008). Symptoms include: a tingling sensation in the thumb due to pressure on the nerve, tenderness, increased pain, numbness, clumsiness, and weakness in the hand (Ansari 2009).

FRACTURES:

Because of the complexity of the wrist, it can be fractured in many different ways. The most common wrist fractures are that of the carpal scaphoid bone. It is usually injured as a result of forced hyperextension, such as a fall on an outstretched hand. Symptoms include pain and swelling through the wrist, as well as localized pain between the thumb and radius around the wrist (Walsh 2004). Another type of wrist fracture is the Bennett’s fracture, which is a fracture plus dislocation of the metacarpal bone at the base of the thumb. The carpometacarpal joint of the thumb becomes disrupted by the fracture line. This fracture involves the joint surface and is often significantly displaced. A blow against a partially flexed metacarpal usually causes Bennett’s fracture (Drelich 2004). Colle’s fractures are fractures of the radius closest to the wrist with displacement. Usually these types of fractures result from a fall on an outstretched hand. They can also be caused by a shortening of the radius/the ulna becoming too long and impacting against the wrist bones. Symptoms include pain, swelling, weakness, a visible deformity of the wrist, crepitus, limitation of finger motion, numbness, and tenderness (Belloti 2007). A Boxer’s fracture is a fracture to the metacarpal, also known as hand, bones. More specifically, this injury affects the knuckles of the pinky and ring finger (4th and 5th metacarpal). Fractures to this portion of the hand usually occur as a result of punching a hard object, hence the origin of the
name (Drelich 2004). Finger fractures occur in one of two places, either on the finger bone itself (the shaft) or within the joint (interarticular) (Peterson 2006).

BOUTONNIERE DEFORMITY:

A Boutonniere Deformity generally arises when there is a rupture on the central extensor tendon slip near the middle of the phalange. It is characterized by an inability to actively extend the proximal phalangeal joint (Torg 1987). This deformity usually occurs when an injury to the finger causes sudden bending at the P.I.P. (proximal interphalangeal) joint. Typically, however, this deformity does not come on straight away and so it not usually recognized immediately (Cardon 2000). Central slip ruptures result in gradual development of bending at this joint and over-straightening at the end joint of the finger. The lateral bands gradually slip sideways around the finger and bend the joint rather than straighten it (Peterson 2006).

MALLET FINGER:

Mallet finger is a common athletic injury and occurs when the tendon of the extensor digitorum muscle ruptures. The tendon, located on the back of the hand, becomes separated from the muscle and usually a fracture is present as well. This injury can result from flexion or hyperflexion against some form of resistance. The symptoms include pain, tenderness, and swelling at the outermost joint immediately after the injury, as well as an inability to extend the finger (Peterson 2006).
Rehabilitation

RANGE OF MOTION/ STRETCHING EXERCISES

Pronation/Supination Stretch:
   With the elbow flexed to 90 degrees, rotate the forearm so that the palms face upward (Fig 3-1A). Hold this position for 10 seconds. Then rotate the arm so that the palms face downward (Fig 3-1B), hold for 10 seconds. Repeat

Radial/Ulnar Deviation Stretch:
   With the elbow flexed to 90 degrees, rest the forearm on a table so that the wrist is hanging off the edge. Make a fist and rotate the forearm up so the thumb is towards the ceiling. Flex the wrist and hold this stretched position for 10 seconds (Fig 3-2A). Then extend the wrist as far as possible and hold this stretched position for 10 seconds (Fig 3-2B). Repeat

Thumb ROM:
   Touch the thumb to the tip of each finger. Progress until the thumb can be flexed to the base of the little finger (Fig 3-3A) (Fig 3-3B). Practice adduction and abduction by lifting the thumb away from the hand and then lowering it back towards it.
Wrist Flexor:
Place the palms of the hands together and push while raising the elbows upward. Hold this stretched position (Fig. 2-3)

Wrist Extensor:
Place the backs of the hands together and push while lowering the elbows towards the floor. Hold this stretched position (Fig. 2-4)

STRENGTHENING EXERCISES

Wrist Flexion:
Place the forearm of the injured arm on a flat surface with the palm up and the elbow bent to 90 degrees. Grasp a dumbbell in the injured hand and allow it to pull the wrist into the fully extended position (towards the floor) (Fig 3-4A). Slowly flex the wrist by bringing it up towards the body as far as possible (Fig 3-4B). Hold this position for 2 seconds, lower, and repeat.

Wrist Extension:
Place the forearm of the injured arm on a flat surface with the palm down and the elbow bend to 90 degrees. Grasp a dumbbell and allow it to pull the wrist into the fully flexed position (towards the floor) (Fig 3-5A). Slowly extend the wrist by bringing it up towards the body as far as possible (Fig 3-5B). Hold this position for 2 seconds, lower, and repeat.
Radial/Ulnar Deviation Exercises:
Place the forearm on a flat surface with the thumb facing up. Grasp a dumbbell and allow it to pull the wrist down into the fully flexed position (towards the floor) (Fig 3-6A) with radial deviation. Pull the wrist up as far as possible into the fully extended position (towards the body) (Fig 3-6B) with radial deviation. Continue doing this back and forth for one minute.

Pronation/Supination Exercises:
Perform the pronation/supination stretch described above, except give resistance with the opposite hand. (Fig 3-1A and Fig 3-1B)
Chapter 4: Back
**Anatomy**

The normal anatomy of the spine is usually described by dividing the spine into three major sections: the cervical (neck), thoracic (mid-back), and lumbar (low-back) spine. Each section is made up of individual bones called vertebrae. There are 7 cervical vertebrae, 12 thoracic vertebrae, and 5 lumbar vertebrae. Each vertebra is made up of several parts. The body of the vertebrae is the primary area of weight bearing and provides a resting place for the discs which separate the vertebrae from each other. The lamina covers the spinal canal, which is the large hole in the middle of the vertebrae where the spinal cord passes. The spinous process is the pointy bone that sticks off the back. These are the bumpy ridges you feel if you run your hand down your back. Also, there are the transverse processes which lay perpendicular to the spinous process and provide attachment for the back muscles (Van De Graaff 2002). Each vertebra contains four facet joints, a pair that face upward and a pair that face downward. These joints interlock with the vertebrae above and below them to connect the spine and provide stability. As mentioned earlier, the vertebrae are separated by discs. These discs act as cushions between the bones. Each disc has two layers, a tough outer layer called the annulus and a soft center called the nucleus. When a disc herniates or ruptures, the moist nucleus bulges out through a tear in the annulus and can compress a nerve root (Lippert 2006). At the bottom of the spine there are two more bones, these are called the sacrum and the coccyx, commonly known as the tailbone.

On the front of the body you have the rib cage, which attaches the vertebral column to the sternum and houses some essential organs, such as the heart and lungs. There are 12 ribs on each side, totaling 24. The top seven are referred to as true ribs because they connect directly to the sternum. The next three (ribs 8-10) are called false ribs because they attach to the sternum.
through cartilage on the seventh rib. Lastly, the 11th and 12th ribs are called floating ribs because they do not connect to the sternum at all, only to the spine. The sternum is the long, flat bone located in the front, middle of the chest. It contains three parts, the manubrium (top), body (middle), and xiphoid process (bottom) (Van De Graaff 2002).

The back has many strong muscles because it needs to stabilize the torso during many basic movements. The latissimus dorsi muscles (also known as the lats) are the largest muscles of the back. These fan-shaped muscles attach to the top of each humerus (arm) and come together to run down the vertebral column and pelvic girdle. The lat muscles allow the body to perform any sort of pulling motion. The trapezius muscle is a long, trapezoid-shaped muscle that starts at the base of the skull, runs down the top of the spinal cord, and attaches down in the middle to lower back (Van De Graaff 2002). This muscle assists in many shoulder movements, such as shrugging. The erector spinae is a group of muscles that support the spinal column. They include the longissimus, the spinalis, and the iliocostalis. The muscles of the erector spinae attach to the vertebrae, the ribs, and the pelvis. Their function is to extend the spine, as well as provide support for it (Lippert 2006). When discussing the back, it is also important to note the core stabilizing muscles which help to flex the vertebral column. A very important core stabilizer is the rectus abdominis. This long, straplike muscle is entirely enclosed in a fibrous sheath and runs from the bottom of the sternum to the top of the pelvis anteriorly. The external and internal obliques run along the lateral walls, or the side of the body. The transverse abdominis is the deepest of the abdominal muscles and it runs horizontally across the abdomen. All of these muscles stabilize the spine during heavy lifting (Van De Graaff 2002).
Common Injuries

MECHANICAL LOW BACK PAIN:

Almost everyone will experience low back pain at some point in their lives. Pain can vary from mild to severe and be short or long-lived. Low back pain can affect the back anywhere below the ribs and above the legs. The lower back is the connection between the upper and lower body, and it bears most of the body’s weight. Because of these roles, it is easily injured during lifting, reaching, or twisting. Low back pain is often caused by overuse, strain, or injury. Aging also plays a role since bones and muscles tend to lose strength with age which consequently increases the risk of injury (Solomonow 2003).

One of the more common causes of low back pain is muscle soreness from overactivity. Muscles and ligament fibers can be overstretched or injured. This usually characterizes itself as a stiffness or soreness in the lower back and goes away within a few days. Most low back pain is triggered by some combination of overuse, muscle strain, and injury to the muscles, ligaments, and discs that support the spine (Villavicencio 2006). Over time, muscle strain can lead to an overall imbalance in the spinal structure. This results in a constant tension on the muscles, ligaments, bones, and discs which then makes the back more prone to injury or reinjury (Solomonow 2003).

SPONDYLOLYSIS (HYPERMOBILITY SYNDROME):

Spondylolysis, also known as Hypermobility Syndrome, is a stress reaction or fracture of the pars interarticularis, which is a part of the vertebrae (Abel 1985). It usually manifests
itself as a stress fracture, but it is normally caused by congenital weakness. Hyperextension, or bending too far back, is thought to be the main cause of this injury (Wang 2006). Sometimes, spondylolysis produces no symptoms at all unless a disk is herniated or there is sudden trauma. When symptoms are present, they include pain on top of the iliac spine, hamstring spasms, loss of normal lumbar lordosis (the inward curvature of the spine), and limited extension of the lumbar (low-back) spine. (Prentice 2004) Spondylolisthesis is much like spondylolysis in that it is a fracture of the pars interarticularis, however this injury also involves forward slippage of the vertebra (Lippert 2006).

SACROILIAC JOINT DYSFUNCTION:

The sacroiliac joints are formed by the connection of the sacrum to the right and left iliac (top of the pelvis) bones. Essentially, this joint connects the spine to the pelvis (Foley 2006). The sacroiliac joint can become sprained as a result of twisting with both feet on the ground, stumbling forward, falling backward, stepping too far down and landing heavily on one leg, or bending forward with the knees locked during lifting. Any of these mechanisms can produce stretching and irritation of the sacroiliac, sacrotuberous or sacrospinous ligaments (Brolinson 2003). Another common cause of SI joint dysfunction occurs when the cartilage becomes damaged or worn away and the bones begin to rub on one another. Basically any condition that alters the normal walking pattern, or gait, of an individual will place increased stress on the SI joints. The most common symptom of this dysfunction is pain in the lower back or back of the hips (Foley 2006).
DEGENERATIVE DISK DISEASE (DDD):

Degenerative disk disease, also known as spondylosis, is essentially a form of spinal osteoarthritis. This injury is usually due to aging, and it may cause loss of normal spinal structure and function. The degenerative process of spondylosis can affect the cervical (neck), thoracic (mid-back), or lumbar (low-back) regions of the spine. When the cervical region is affected, symptoms include neck and shoulder pain. Sometimes a bone spur, known as an osteophyte, compresses a nerve root which causes that arm to become weak. When the thoracic region is affected, symptoms include pain with flexion (bending forward). When the lumbar region is affected, symptoms include pain and morning stiffness in the low back (Kirkaldy-Willis 1978).

PIRIFORMIS SYNDROME:

Piriformis syndrome is a condition in which the piriformis muscle compresses or irritates the sciatic nerve, which is a large nerve that runs through the pelvis and down the leg. When this irritation occurs, pain is felt in the buttocks and the back of the leg. It is not yet known what causes piriformis syndrome, but some speculations include a tight piriformis muscle which causes spasming and compression of the sciatic nerve against the pelvic bone, and blunt trauma (such as a fall) to the buttocks area causing a hematoma and consequently a swollen piriformis muscle (Filler 2008).

HERNIATED DISK:

Between each vertebrae in the spine is a spongy disk which helps to cushion the spine,
absorb shock, and maintain flexibility. Which one of these disks is damaged it can bulge or break open, this is referred to as a herniated disk. Herniated disks can occur anywhere along the spine, but are most often found in the lumbar region, or the lower back (Lawrence 2006). A herniated disk is usually caused by one of two things, either wear and tear from aging or direct injury to the spine. Tiny tears or cracks in the hard, outer layer of the disk causes the gel-like insides to be forced out, resulting in the aforementioned bulging. When the herniated disk compresses a nerve root, the symptoms include pain, numbness, and weakness in the area of the body that the nerve travels to. Sciatica is the most common symptom of a herniated disk in the low back, resulting in pain and numbness in the buttocks and down the leg. If the herniated disk does not compress a nerve, no symptoms may be present or only a slight backache can be felt (Leone 2000).
Rehabilitation

RANGE OF MOTION/ STRETCHING EXERCISES

Knee Rocking:
While laying flat on the back, bend the knees and slowly rock them from side (Fig 4-1A) to side (Fig 4-1B), keeping the upper body straight.

Pelvic Tilt/Rock:
Get down on hands and knees, keeping everything spread about shoulder/hip width apart. Slowly arch the back down, rocking the pelvis down and sticking the butt out (Fig 4-2A). Then arch the back up, tilting the pelvis back and tucking the tailbone in (Fig 4-2B)

Extension:
Lying flat on the stomach, slowly press the upper body up while keeping the lower body (including the hips) flat against the ground. Extend as far as possible and use arms for support. (Fig 4-3)
Bridge:
Lies flat on back with legs bent to 90 degrees (Fig 4-4A). While keeping the shoulders and head on the ground, lift the hips up off the ground into a “bridge” (Fig 4-4B). Hold this position.

Flexion:
Lying flat on the back, bend legs to 90 degrees and wrap arms underneath. Lift knees up to chest and hold (Fig 4-5). Do both single and double knee to chest.

Sacroiliac Stretch:
Lie on the back on a table or flat, upraised surface. Rotate hips and swing right leg, with knee bent to 90 degrees, over left. Keep shoulders flat on the table and let right leg fall as far as possible over the edge of the table until a stretch is felt (Fig 4-6). Repeat for the opposite side.
Piriformis Stretch:

Sit with legs bent and feet flat on the floor. Place right ankle over left thigh (Fig. 4-7) and hold. Repeat for opposite leg.

Cross-Over Stretch:

Sit on the floor with legs extended in front of you. Bend left leg and cross it over the right at the knee. Twist body so that right arm is on the outside of the left leg. (Fig 4-8) Hold this stretched position for 2 seconds, switch sides, and repeat.
STRENGTHENING EXERCISES

Hip Internal Rotation:
Lie flat on stomach with knees together and bent up at 90 degrees. Put a theraband around ankles and open and close the lower legs, keeping knees together. (Fig 4-9)

![Fig 4-9](image)

Hip Abduction:
Lie on one side and lift top leg as high as possible (Fig 4-10). Lower and repeat 20 times. Do this exercise on both sides.

![Fig 4-10](image)

Hip Extension:
Lie flat on stomach and lift one leg straight up (Fig 4-11). Lower and repeat 20 times. Do this exercise with both legs.

![Fig 4-11](image)
Bird Dog:
Get down on hands and knees, keeping everything spread about shoulder/hip width apart. Lift one arm up and extend it forward while lifting the opposite leg up and extending it back. (Fig. 4-12) Hold for 2 seconds then repeat with other arm and leg.

![Fig 4-12](image)

Crunches (Flexion):
Lie on the back with knees bent to 90 degrees (Fig 4-13A). Lift head, shoulders, and chest up as far as possible, hold for 2 seconds, and lower (Fig 4-13B). Repeat 15 times.

![Fig 4-13A](image) ![Fig 4-13B](image)

Superman (Extension):
Lie flat on stomach with arms and legs extended (Fig 4-14A). Lift both of the arms and legs up off the floor while keeping the torso flat (Fig 4-14B). Hold for 5 seconds, lower, and repeat.

![Fig 4-14A](image) ![Fig 4-14B](image)
Supine Marching:

Lie flat on back with knees bent and feet flat on floor (Fig 4-15A). Lift each leg up individually, bringing the knee towards the chest as if “marching” in place (Fig 4-15B)
Glossary

Abduction – movement away from the midline of the body

Adduction – movement toward the midline of the body

Anterior – refers to the front of the body, or a position closer to the front

Articulation – a joint

Crepitus – a crackling sound, usually caused by the adherence of the paratenon to the surrounding structures while it slides back and forth

Distal – refers to a location further away from the trunk

Dorsal – pertaining to the back of a body part; when dealing with the foot it refers to the top

Eversion – moving the sole of the foot outward at the ankle

Extension – the straightening movement of one bone from another, causing an increase in joint angle

External rotation – aka lateral rotation; the front surface moves outward away from the midline

Flexion – the bending movement of one bone on another, causing a decrease in joint angle

Inferior – refers to a body part or position located below another

Internal rotation – aka medial rotation; the front surface moves inward towards the midline

Inversion – moving the sole of the foot inward at the ankle

Lateral – refers to a location or position further away from the midline

Ligament – a tough cord of connective tissue that binds bone to bone, usually seen in joints to strengthen and provide flexibility.

Medial – refers to a location or position toward the midline

Plantar – pertaining to the sole of the foot

Posterior – refers to the back of the body, or a position closer to the back

Pronation – rotation of the forearm so that palms are facing down

Proximal – refers to a location closer to the trunk
Supination – rotation of the forearm so that palms are facing up

Superior – refers to a body part or position located above another

Tendon – a band of connective tissue that attaches muscle to bone
Works Cited


