

Musculoskeletal Injuries

**EMS Continuing Education
Technician through Technician-Advanced Paramedic**

**Consistent with the
National Occupational Competency Profiles
as developed by
Paramedic Association of Canada
and
“An Alternate Route to Maintenance of Licensure”
as developed by Manitoba Health**

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**Developed by:
Educational Subcommittee – Paramedic Association
of Manitoba**

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Disclaimer

These documents were developed for improved accessibility to standardized continuing education for all paramedics in Manitoba.

This training package is consistent with the National Occupational Competency Profiles and the core competency requirements (both mandatory and optional) as identified in “An Alternative Route to Maintenance of Licensure” (ARML). It is not the intent that this package be used as a stand-alone teaching tool. It is understood that the user has prior learning in this subject area, and that this document is strictly for supplemental continuing medical education. To this end, the Paramedic Association of Manitoba assumes no responsibility for the completeness of information contained within this package.

It is neither the intent of this package to supersede local or provincial protocols, nor to assume responsibility for patient care issues pertaining to the information found herein. Always follow local or provincial guidelines in the care and treatment of any patient.

This package can be used in conjunction with accepted models for education delivery and assessment as outlined in “An Alternative Route to Maintenance of Licensure”. Any individual paramedics wishing to use these continuing education packages to augment their ARML program should contact their local EMS Director.

This document was designed to encompass all licensed training levels in the province (Technician, Technician – Paramedic, Technician – Advanced Paramedic.). Paramedics are encouraged to read beyond their training levels. However, it is suggested that the accompanying written test only be administered at the paramedic’s current level of practice.

This package has been reviewed by the Paramedic Association of Manitoba’s Educational Subcommittee and is subject to review by physician(s) or expert(s) in the field for content.

As the industry of EMS is as dynamic as individual patient care, the profession is constantly evolving to deliver enhanced patient care through education and standards. The Paramedic Association of Manitoba would like to thank those practitioners instrumental in the creation, distribution, and maintenance of these packages. Through your efforts, our patient care improves.

This document will be amended in as timely a manner as possible to reflect changes to the National Occupational Competency Profiles, provincial protocols/Emergency Treatment Guidelines, or the Cognitive Elements outlined in the Alternate Route document.

Any comments, suggestions, errors, omissions, or questions regarding this document may be referred to info@paramedicsofmanitoba.ca , attention Director of Education and Standards.

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Introduction to the Musculoskeletal System

Musculoskeletal injuries are among the most common problems you may see as an EMS provider. Appropriate care of musculoskeletal injuries immediately relieves pain and decreases the possibility of shock and further nerve or vessel injury. This care will also improve the patient's chances for a rapid recovery and early return to normal activity.

This module will aid EMS personnel in understanding the Anatomy and Physiology of the musculoskeletal system; how it functions as part of the human body and how to treat possible injuries which relate to the system.

Conventions Used in this Manual

Black lettering without a border is used to denote information appropriate to the Technician Level and above.

| Text with the single striped border on the left is information appropriate to Technician - Paramedic and above.

|| Text with the double striped border on the left is information appropriate to Technician – Advanced Paramedic.

Anatomy and Physiology

Introduction to the Skeletal System

The skeletal system consists of bones and associated connective tissue, including cartilage, tendons, and ligaments. The skeletal system provides a rigid framework for support and protection of our vital organs. It also provides a system of levers on which muscles act to produce body movements. The skeletal system contains 206 individual bones. Some of the larger bones in the skeletal system produce red blood cells (in the bone marrow) and serve as a reservoir for important minerals and electrolytes.

The Axial Skeleton

The axial skeleton consists of the skull, hyoid bone, vertebral column, and thoracic cage. The skull is composed of the parietal, temporal, frontal, occipital, sphenoid, and ethmoid bones that form the cranium. 6 auditory ossicles (3 on each side) function in hearing, and 14 bones make up the face.

The hyoid bone is attached to the skull by muscles and ligaments and “floats” in the superior aspect of the neck, below the mandible. The hyoid bone serves as the attachment point for several important neck and tongue muscles. The hyoid bone is the only bone in the human body that is not connected to another bone.

The vertebral column consists of 26 bones, divided into 5 regions: 7 cervical vertebrae, 12 thoracic vertebrae, 5 lumbar vertebrae, 5 sacral vertebrae fused into 1 bone, and 4 or 5 coccygeal vertebrae fused into 1 bone. The bony spinal canal formed by the vertebrae encases and protects the spinal cord. The weight-bearing portion of the vertebrae is a bony disk called the body. Intervertebral disks, located between the bodies of adjacent vertebrae, serve as shock absorbers for the vertebral column, provide additional support for the body, and prevent the vertebral bodies from rubbing against each other.

The thoracic cage protects vital organs within the thorax and prevents the collapse of the thorax during respiration. It is made up of the thoracic vertebrae, ribs with their associated connective cartilage, and the sternum. The 12 pair of ribs can be divided into the 7 pair of true ribs, which attach to the vertebrae posteriorly and sternum anteriorly. The 5 pair of false ribs connects to the vertebrae posteriorly, but do not attach directly to the sternum. The eleventh and twelfth ribs are “floating” and have no attachment to the sternum. The sternum is divided into the manubrium, body and xiphoid process. These divisions are frequently used for anatomical landmarks in patient assessments.

The Appendicular Skeleton

The appendicular skeleton consists of the bones of the upper and lower extremities and their girdles, by which they are attached to the body. The upper limbs attach to the axial skeleton at the sternoclavicular joint between the sternum and the clavicle. The head of

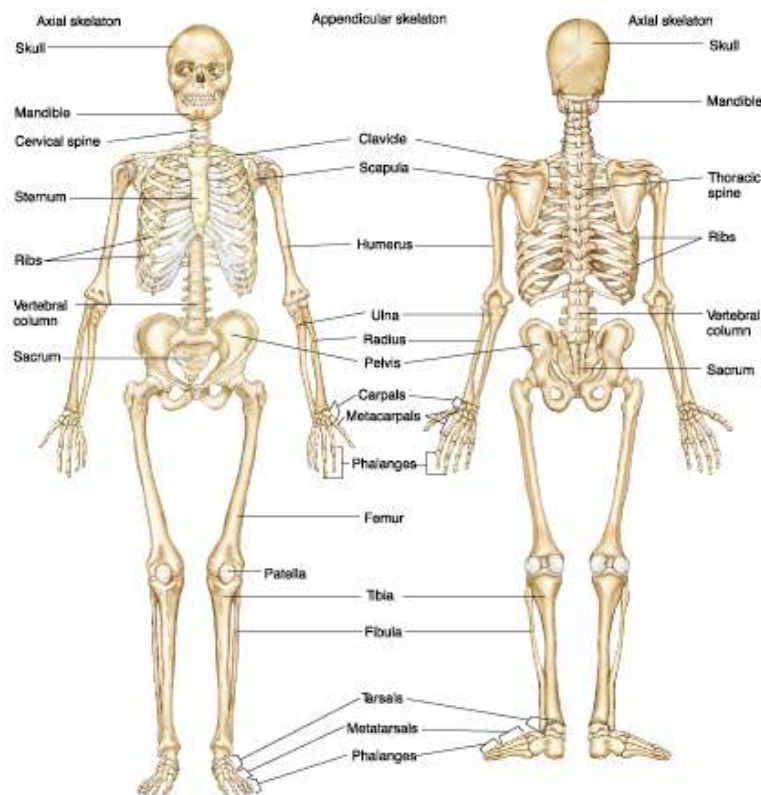
the humerus articulates at its proximal end with the scapula, and distally with the radius and ulna. The humerus is the second longest bone in the body.

The wrist is composed of 8 carpal bones, which are arranged in two rows of four each. 5 metacarpals attach to the carpals, forming the framework of the hand. 14 phalanges make up the four fingers (3 phalanges each) and the thumb (2 phalanges).

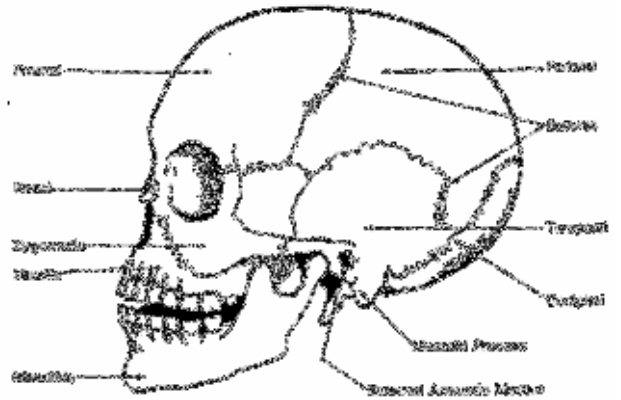
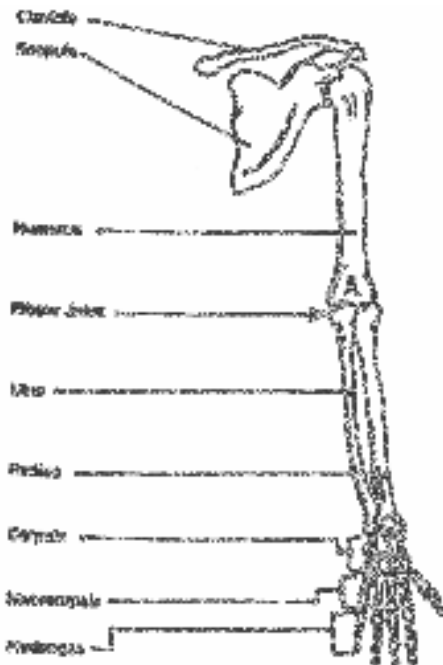
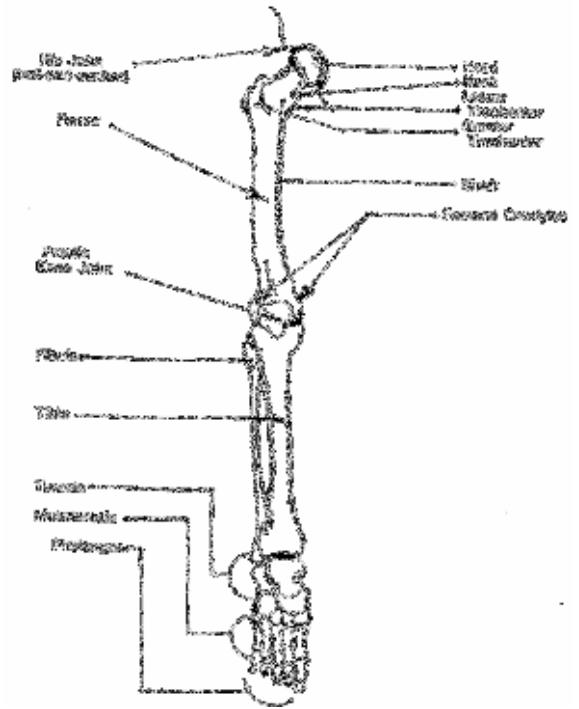
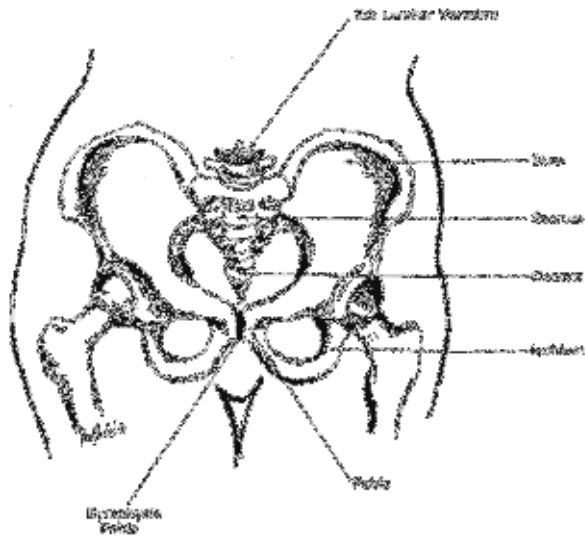
The pelvic girdle attaches the legs to the trunk of the body. The longest bone in the body is the femur, which articulates as a ball and socket joint at the hip at its proximal end. Distally, the femur articulates with both the patella and tibia. The tibia is the larger of the two lower leg bones and supports most of the weight of the body. The fibula does have a small proximal end, which articulates with the tibia. Distally, the tibia and fibula help to form the medial and lateral aspects of the ankle joint respectively.

The foot consists of 7 tarsals, 5 metatarsals, and 14 phalanges, which are arranged in a manner similar to the hand. The great toe is analogous to the thumb in that it only has two phalanges.

The bones of the skeleton provide a framework to which the muscles and tendons are attached. Bone is a living tissue that contains nerves and receives oxygen and nutrients from the arterial system. Therefore, when a bone breaks, the patient typically experiences severe pain and bleeding.

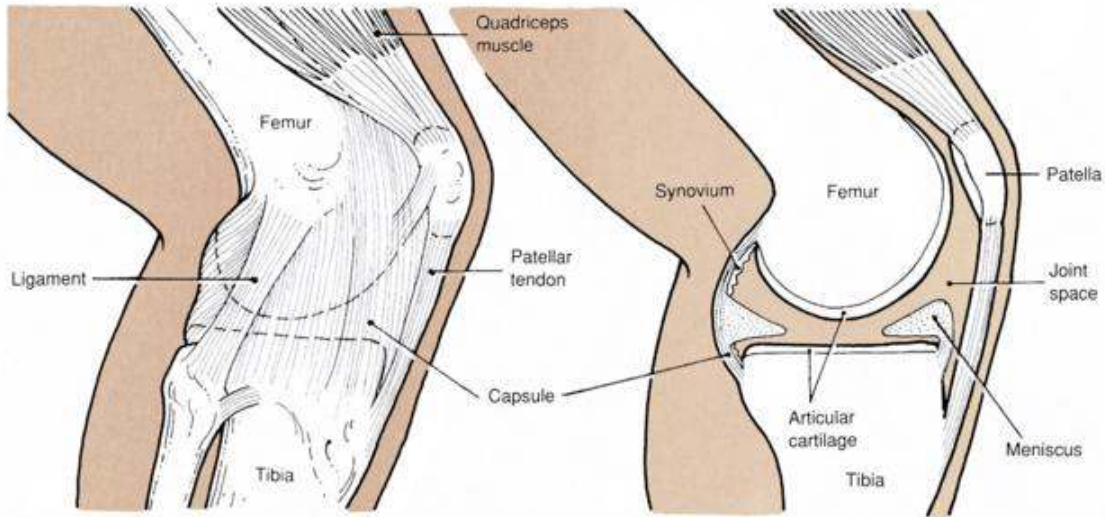


Various Bones of the Body



Anatomy and Physiology of Joints

A joint is an area where two bones are connected for the purpose of motion in the body parts. Joints may also be referred to as an ARTICULATION or ARTHROSIS. The connections are commonly named according to the bones that are united at that joint. The three major classifications of joints are fibrous, cartilaginous, and synovial.



A joint consists of bone ends, the fibrous joint capsule, and ligaments. The degree to which a joint can move is determined by how the ligaments hold the bone ends and by the configuration of the bones themselves.

Immovable or Fibrous Joints

Fibrous joints consist of bones united by fibrous tissue that have little or no movement. An example of a fibrous joint would be the skull, which is joined by connective tissue called sutures.

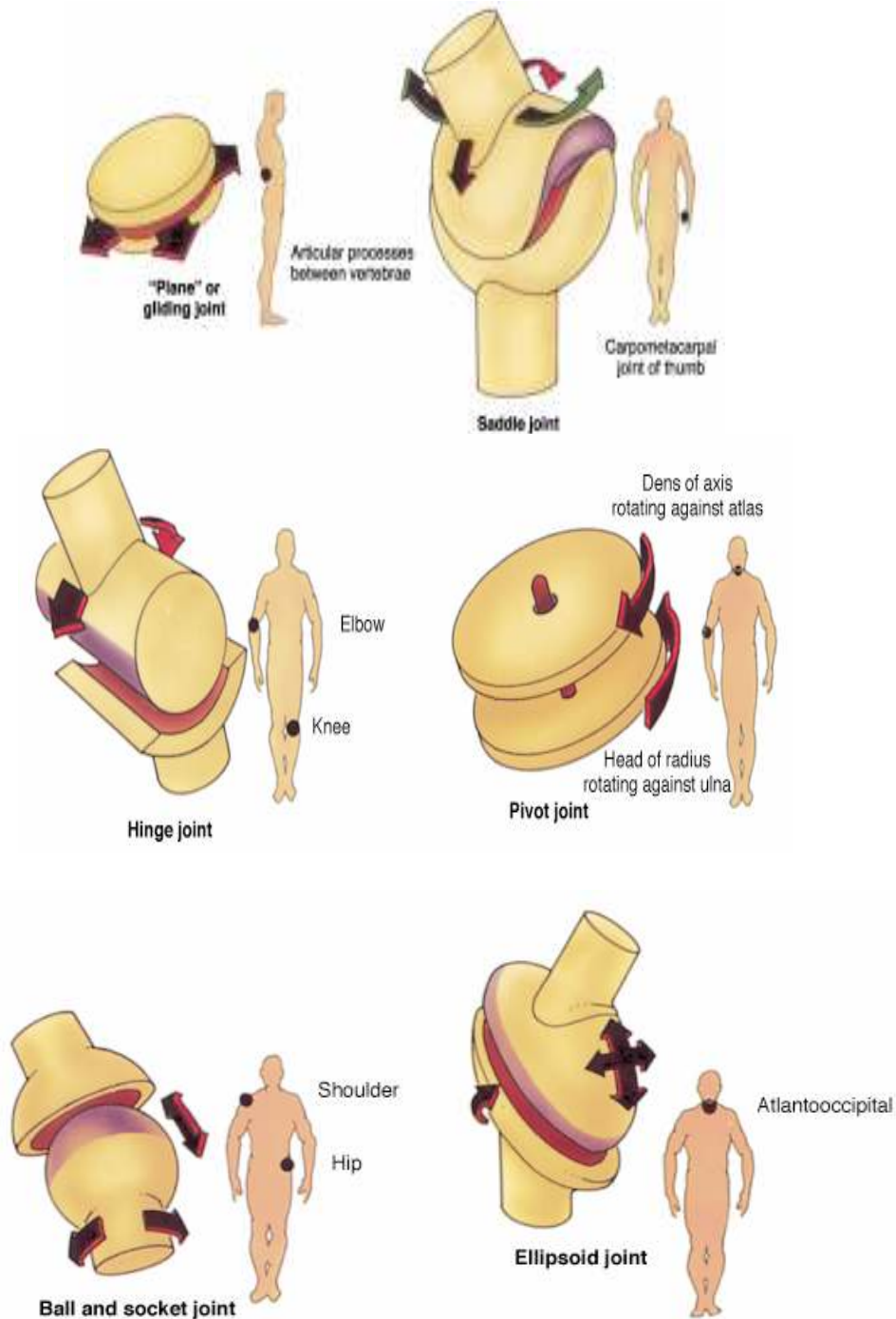
Cartilaginous Joints

These joints unite two bones by means of hyaline cartilage or fibrocartilage. Examples of these types of joints are the epiphyseal plate of a growing bone and the junction between the manubrium and the body of the sternum.

Synovial Joints

Synovial joints contain synovial fluid, a thin, lubricating film that allows considerable movement between articulating bones. Most of the joints in the appendicular skeleton are synovial. The bones within the synovial joints are covered with a thin layer of cartilage, which provides a smooth surface where the bones meet. The joint is enclosed by a joint capsule which produces synovial fluid, which keeps the joint lubricated. Based on the shape of the adjoining surfaces, synovial joints are classified into 6 divisions:

- ❖ Plane or Gliding Joints (articular processes between vertebrae)
- ❖ Saddle Joints (carpometacarpal joint of the thumb)
- ❖ Hinge Joints (elbow or knee)
- ❖ Pivot Joints (head of radius articulating with the proximal end of the ulna)
- ❖ Ball-and-socket Joint (shoulder and hip)
- ❖ Ellipsoid Joint (base of skull, atlantooccipital joint)

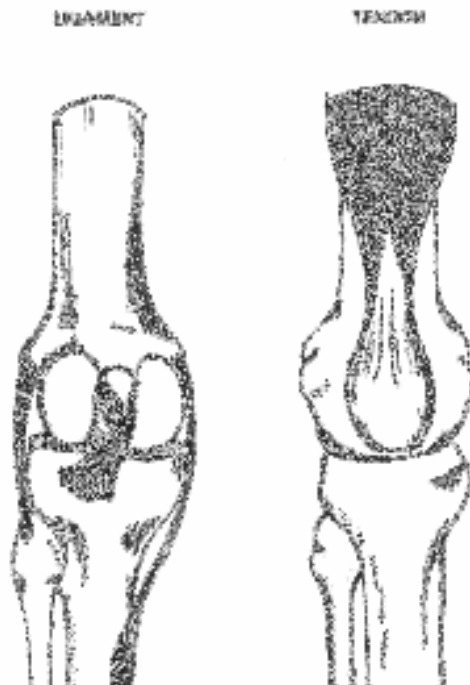


Connective Tissue of the Musculoskeletal System

The three primary elements of the musculoskeletal system responsible for movement of the body are:

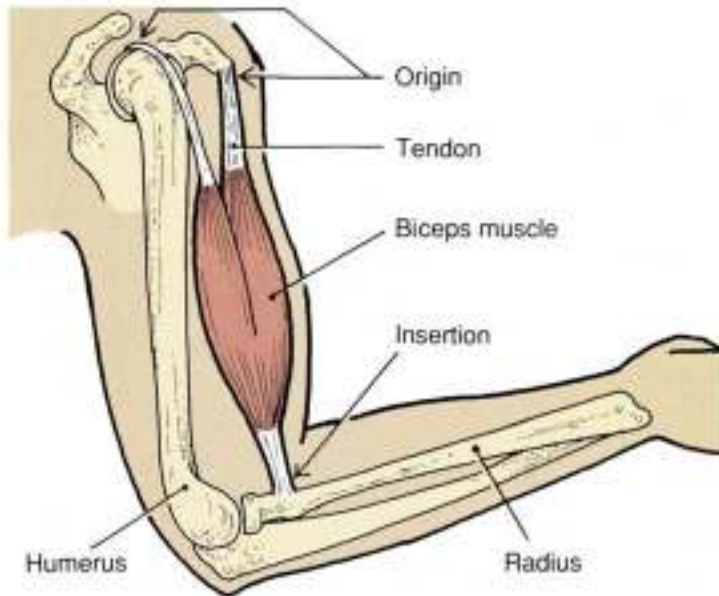
- ❖ Ligaments – a tough band of connective tissue that connects various structures such as bone to bone. They will stretch to facilitate joint movement.
- ❖ Tendons – softer connective tissue that attaches muscle to bone. It is somewhat flexible, but tough. When a tendon becomes inflamed, the condition is referred to as tendonitis. Inflamed tendons are at risk for rupture.
- ❖ Muscles – tissue consists of specialized contractile cells or muscle fibers. These fibers receive a nervous impulse, which stimulates a chemical reaction, causing the muscles to contract.

Ligaments and Tendons



The three types of muscles in the body are skeletal, smooth, and cardiac. Skeletal muscle is by far the most common. It allows movement and is mostly under voluntary control. Skeletal muscle is referred to as striated muscle because of its characteristic stripes. There are more than 600 muscle groups making up the muscular system, which provide the major muscle mass of the body. The three primary functions of the muscular system are movement, postural maintenance, and heat production.

Muscles



The biceps muscle causes the elbow to bend when it contracts. Note the points of tendon origin and insertion. As the muscle contracts and shortens, these points are pulled closer together, with motion occurring at the elbow joint.

Skeletal Muscle Movement

Most muscles extend from one bone to another and cross at least one joint. Muscle contraction causes most body movements by pulling one of the bones toward the other across a movable joint. The points of attachment of each muscle are the origin and the insertion. The origin is the end of the muscle attached to the more stationary of the two bones. The insertion is the end of the muscle attached to the bone undergoing the greatest movement. Facial muscles are attached to skin at one end, causing the skin to move when stimulated.

Body Movement Terminology

Flexion- bending

Extension- stretching out

Protraction- movement in the anterior direction

Retraction- movement in the posterior direction

Abduction- movement away from the midline

Adduction- movement toward the midline

Inversion- turning inward

Eversion- turning outward

Excursion- movement from side to side

Rotation- movement of a structure about its axis

Circumduction- movement in a circular motion

Pronation- rotation of the forearm so that the anterior surface is down

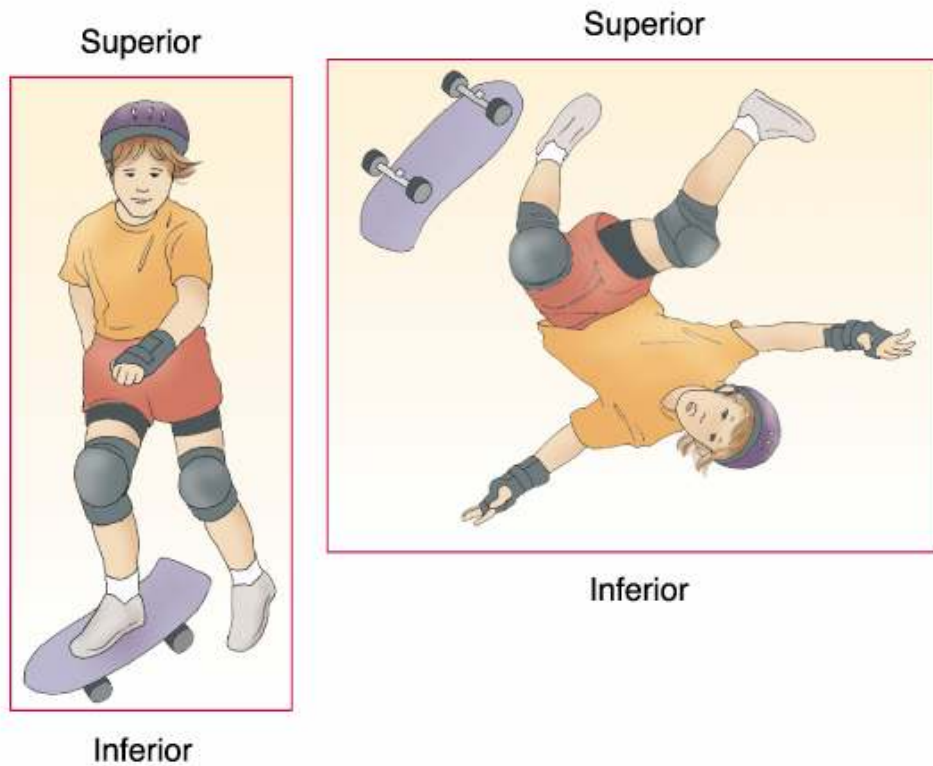
Supination- rotation of the forearm so that the anterior surface is up

Elevation- movement of a structure in a superior direction

Depression- movement of a structure in an inferior direction

Opposition- movement of the thumb and little finger toward each other

Reposition- movement of a structure to its original position



Postural Maintenance

Postural maintenance is a result of muscle tone, the constant tension produced by muscles of the body for long periods. The tone is responsible for keeping the back and legs straight, the head in an upright position, and the abdomen from bulging. These positions balance the distribution of weight, and therefore put less strain on muscles, tendons, ligaments and bones.

Heat Production

The metabolism in skeletal muscle is largely responsible for the maintenance of a normal body temperature. If the body temperature declines below a certain level, the nervous system responds by inducing shivering. Shivering involves rapid contractions of skeletal muscle that produce shaking. This muscle movement increases heat production up to 18 times that of resting levels, helping to raise body temperature back to normal.

Significance of Kinetics in Traumatic Injuries

Traumatic injury occurs to the body when the body's tissues are exposed to energy levels beyond their tolerance. Three concepts of energy are typically associated with injury (not including thermal energy, which causes burns): *work*, *kinetic energy*, and *potential energy*. In considering the effects of energy on the human body, it is important to remember that energy can be neither created or destroyed, but can only be converted or transformed. It is not the objective of this section to help you to reconstruct the scene of a motor vehicle collision. Rather, you should have a sense of the effects of work on the body and understand, in a broad sense, how work is related to potential and kinetic energy. For example, when you are assessing a patient who fell, you need not calculate the speed at which the person hit the ground. However, it is important to estimate the height from which he or she fell and to appreciate the injury potential of the fall.

Work is defined as *force acting over a distance*. For example, the force needed to bend metal multiplied by the distance over which the metal is bent is the work that crushes the front end of an automobile that is involved in a frontal impact. Similarly, forces that bend, pull, or compress tissues beyond their inherent limits result in the work that causes injury.

The energy of a moving object is called **kinetic energy** and is calculated as follows: *Kinetic energy* = $\frac{1}{2}mv^2$, where *m* = mass (weight) and *v* = velocity (speed). Remember that energy cannot be created or destroyed, only converted. In the case of a motor vehicle collision, the kinetic energy of the moving vehicle is converted into the work of stopping the vehicle, usually by crushing the vehicle's exterior.



Similarly, the passengers of the vehicle have kinetic energy because they were traveling at the same speed as the vehicle. Their kinetic energy is converted to the work of bringing them to a stop. It is this work on the passengers that results in injury. Notice that, according to the equation for kinetic energy, the energy that is available to cause injury doubles when an object's weight doubles but quadruples when its speed doubles. Consider the debate over raising the speed limit. Increasing a 2000 pound vehicle's speed from 50 mph to 70 mph doubles the energy that is available to cause injury.

$$Ke = \frac{1}{2} mv^2$$

$$Ke \text{ for 2000 lbs vehicle traveling 50 mph} = 1000X(50^2) = 2,500,000$$

$$Ke \text{ for 2000 lbs vehicle traveling 70 mph} = 1000X(70^2) = 4,900,000$$

This point will be even clearer in considering gunshot wounds. The speed of the bullet (high-velocity compared with low-velocity) has a greater impact on producing injury than the mass (size) of the bullet. As has already been noted, this is why it is so important to report to the hospital the type of firearm that was used in a shooting. The amount of kinetic energy that is converted to do work on the body dictates the severity of the injury. High-energy injuries often produce such severe damage that patients can be saved only by immediate transport to an appropriate facility.

Potential energy is the product of mass (weight), force of gravity, and height and is mostly associated with the energy of falling objects. A worker on a scaffold has some potential energy because he or she is some height above the ground. When the worker falls, potential energy is converted into kinetic energy. As the worker hits the ground, the kinetic energy is converted into work – that is, the work of bringing the body to a stop and thereby breaking bones and damaging tissues.

Musculoskeletal Injuries: Identification and Assessment

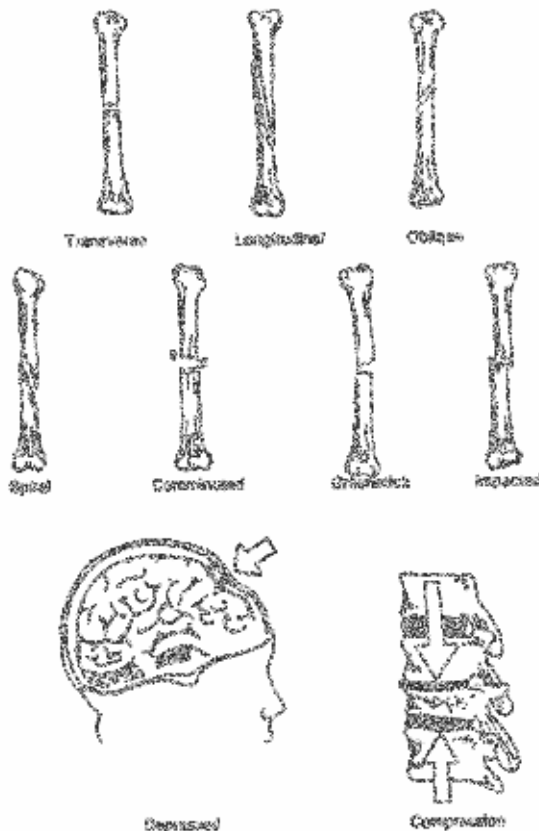
Fractures

A fracture is defined as “any break in the continuity of a bone”.

- ❖ **Open Fractures:** where the overlying skin has been broken, either by the bone ends or other trauma.
- ❖ **Closed Fractures:** where the skin above the fracture is not broken, and bones are not protruding.
- ❖ **Non-Displaced Fracture:** where the bone is not moved from its original alignment. i.e. Hairline Fracture.
- ❖ **Displaced Fracture:** where the bones original alignment has been altered from the normal position.

Classifications of Fractures

- ❖ **Transverse:** bone is broken cross-wise or perpendicular to the bone. Caused by a direct force.
- ❖ **Longitudinal:** bone is split length wise
- ❖ **Oblique:** bone is split diagonally.
- ❖ **Spiral:** fracture line is a spiral or S shape. Usual caused by a twisting force.
- ❖ **Comminuted:** where the bone is broken into 2 or more fragments.
- ❖ **Greenstick:** is when the fracture line does not split the bone completely in half. Commonly found in children.
- ❖ **Impacted:** where bone ends are jammed together.
- ❖ **Depressed:** where a direct blow drives a fragment of the bone below the surface of the bone layer.
- ❖ **Compression:** where 2 bones are removed from original position, and jammed/compressed together. This is found mainly in the spine.
- ❖ **Pathologic:** a fracture of weakened or diseased bone, seen in patients with osteoporosis or cancer. Generally produced by minimal force.
- ❖ **Epiphyseal:** a fracture that occurs in the growth section of a child's bone. This fracture must be treated appropriately to avoid permanent damage.



Classification of Fractures

Signs and Symptoms

- ❖ **Deformity:** limb may appear shortened, rotated, or angulated at a point where there is no joint. Always use the opposite limb for comparison.
- ❖ **Point Tenderness:** upon palpation of a fracture site, it will be tender to touch, as well as painful for the patient.
- ❖ **Guarding:** the inability to use the extremity as the patient's way of immobilizing the limb to reduce pain.
- ❖ **Swelling:** rapid swelling, usually indicates bleeding from a fracture site. Is often followed by extreme pain.
- ❖ **Bruising:** ecchymosis (discoloration) of the surrounding area is common in fractures.
- ❖ **Crepitus:** a grating or grinding sensation, which can be felt, or even heard when bone ends rub together.
- ❖ **False Motion:** motion in a limb where there is no joint to cause the motion.
- ❖ **Exposed Fragments:** bone ends visible through an open wound in the skin.
- ❖ **Pain:** along with tenderness and bruising, is common with fractures.
- ❖ **Locked Joint:** a joint that is locked in position makes attempts to move the joint difficult and painful.

Dislocations (Luxations)

A dislocation is when there is displacement of a long bone or other structure from its normal anatomical location.

Signs and Symptoms

- ❖ swelling
- ❖ pain with movement
- ❖ tenderness
- ❖ loss of motion
- ❖ numbness
- ❖ impaired circulation
- ❖ deformity

Strain

A strain is the over-stretching of a muscle, and presents pain, usually when attempting to use the affected muscle. There are no signs of bleeds or ecchymosis with strains.

Signs and Symptoms

- ❖ acute tearing pain at time of injury
- ❖ stiffness and pain when moving the affected area
- ❖ spasm in area of the strain
- ❖ generally no deformity, swelling or discoloration

Sprain

A sprain is a partial or complete tearing of ligaments and other tissues of a joint. The joint is also displaced during the sprain, but it falls back into place after impact.

Signs and Symptoms

- ❖ pain
- ❖ immediate swelling
- ❖ inability to use joint
- ❖ discoloration

Musculoskeletal Injuries: Assessment and Management

Musculoskeletal system trauma resulting in fractures or dislocations requires prompt and careful management. Strains, sprains, fractures and dislocations are often difficult to differentiate. All strains, sprains, fractures and dislocations should be immobilized and splinted prior to transport, unless other life threatening injuries require immediate attention.

Assessment

- ❖ Personal protective equipment and body substance isolation techniques should be utilized as appropriate.
- ❖ Primary survey
- ❖ During the detailed (secondary) assessment, one member of the EMS team should immobilize the injured extremity while the other member exposes and examines the injury site. An assessment of the limb's distal neurologic and vascular status should be done at this time.
- ❖ Provide supplemental oxygen based on the patient's presenting condition and vital signs.
- ❖ Consider load and go criteria.
- ❖ Document wound characteristics
 - open or closed
 - foreign body, object, or debris
 - distal circulation, color, and warmth
 - distal neurologic status
- ❖ Obtain a pertinent history
 - injuries identified by patient
 - time of injury
 - mechanism of injury
 - past medical history
 - medications
 - allergies
 - last meal

- ❖ Treat for shock, if indicated
- ❖ Treat all wounds and injuries as per the appropriate guideline
- ❖ Do not allow the patient to exert him/herself – e.g. walking, standing unassisted to transfer to the stretcher, etc.
- ❖ Initiate transport, keeping on scene times to a minimum and handle the patient gently and carefully.

- ❖ Transport the patient to the nearest appropriate health care facility.
 - notify the receiving facility of the patient's status
 - monitor and treat the patient en route
 - monitor distal circulatory and neurological status en route, and be prepared to adjust the bandages and dressings if status is compromised by the dressing or bandages.
 - transport patient in position of comfort, injuries permitting
 - report all findings to the receiving facility staff, and document on the patient care report
- ❖ Distal circulatory and neurological status must be reassessed after applying dressings and bandages

Basic Fracture and Dislocation Management

- ❖ Inform the patient of actions and interventions that will be done to assist the patient
- ❖ The primary objective of fracture and dislocation management is to support and prevent movement of injured areas of the body, and to prevent further injury due to movement of the injured area.
- ❖ Splint all injuries prior to moving the patient, except in load and go situations
 - in load and go situations there may not be adequate time to provide complete splinting. Initial attempts at splinting must be made to minimize movement of any injuries. This is especially true if a fractured femur or pelvis is present or suspected. Failure to splint a fractured femur or pelvis may result in excessive blood loss.
 - splinting of injuries may need to be delayed while life saving interventions are initiated and continued. Any delays in splinting, and the reasons for delay, should be documented on the patient care report.
 - Critical patients should not be delayed in transport by detailed and lengthy examinations and treatment for non-critical injuries. Prevention of damage may be achieved by spinal immobilization, when other injuries demand prompt transport.
- ❖ Clothing at or near the injury site should be removed.
- ❖ Jewelry distal to the injury should be removed and secured. Disposition of valuables should be noted on the patient care report.
- ❖ All wounds should be treated and dressed. Bleeding from a wound at the injury site should be controlled without direct pressure immediately over the injury site.
- ❖ Stabilize the joint above and below any fracture or suspected injury.
- ❖ Ensure that all splints utilized are adequately padded and applied firmly but not so tight that distal circulation is impaired. Body hollows should be padded if possible.

- ❖ Hands and feet should be immobilized in the position of function.
- ❖ After identifying and treating a fracture, continue on with assessment to make sure it is the only injury. It is easy to miss a fracture proximal to the visible one.
- ❖ Secure the patient to an appropriate lifting or immobilization device and, if possible, elevate the injured extremity.
- ❖ Following any movement or treatment of the patient, the splinting should be reassessed.
- ❖ Patients with severe head trauma, altered level of consciousness, and/or drug/alcohol influences should be examined carefully and conservatively treated, as there may be a reduced perception of pain by the patient.
- ❖ Assess and record the circulatory and neurological status distal to the injury prior to and following treatment.
- ❖ Transport the patient carefully to the nearest appropriate health care facility. A smooth, careful transport should be conducted.
- ❖ Record all observations and treatments and report this information to the medical staff at the receiving health care facility.

Treatment of Fractures

Fractures (excluding joints)

- ❖ Fractures are splinted in the position found unless
 - limb is so severely angulated it presents problem with transportation
 - distal pulse is absent
- ❖ If one of the above conditions is present:
 - one (1) attempt is made to correct the problem
 - apply gentle in-line traction distal to the injury site in the direction the limb is lying and re-aligning the limb to its relative position
 - limb must be supported throughout the re-alignment
 - if resistance to the re-alignment is noted then the re-alignment must be stopped and limb must then be splinted.
 - any changes to neurological or circulatory status must be documented
- ❖ Load and go should be implemented if distal neurological and circulatory status is compromised.

Fractures involving Joint

- ❖ Immobilize and splint the injury in the position found.
- ❖ Load and go should be implemented if distal neurological and circulatory status is compromised.

Pelvic Fractures

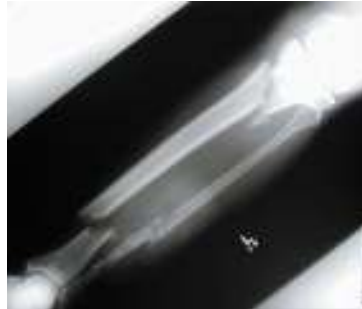
- ❖ Position patient supine on backboard or scoop, moving patient as little as possible.
- ❖ If movement is necessary, do so without bending hip or waist area.
- ❖ Pad and immobilize pelvis, using a pillow or blanket and two cravats to hold padding in place.

Hip Fracture

- ❖ Immobilize patient's pelvic area as per pelvis fracture.
- ❖ Splint affected leg so as not to allow movement of the hip joint.
- ❖ Check the pulses distal to the injury.

Clavicle and Scapula Injuries

- ❖ Apply a sling to slightly elevate the arm.
- ❖ Swathe a bandage to hold it to the chest to prevent movement.



For unstable fractures with neurological or circulatory compromise, load and go should be implemented.

Crush Injuries

A crushing injury occurs when a great amount of force is applied to the body. The extent of the damage depends on just how long that period is. In addition to causing some direct soft-tissue damage, continued compression of soft tissues will cut off their circulation, producing further tissue destruction. For example, if a patient's legs are trapped under a collapsed pile of rocks, damage to the leg tissues will continue until the rocks are removed. Crush injuries will be discussed in greater detail in the soft tissue injuries package.



The damage associated with a crush or compression injury varies depending on the direct damage to the soft tissues and on how long the tissue was cut off from circulation.

Evaluation of Neurovascular Function

Many important blood vessels and nerves lie close to the bone, especially around the major joints. Therefore, any injury or deformity of the bone may have associated vessel or nerve injury. For this you must assess neurovascular function during the detailed physical exam, repeating it every 5 to 10 minutes, depending on the patient's condition.

Always recheck the neurovascular function before and after you splint or otherwise manipulate the placement of a limb. Failure to restore circulation in this situation can lead to death of the limb, or vessel/nerve damage.

Examination

Pulse: palpate the pulse distal to the point of injury. Palpate the radial pulse in the upper extremity, and the posterior tibial pulse, and dorsalis pedis pulse in the lower extremity.

Motor Function: evaluate muscular activity when the injury is proximal to the patients hand or foot. Ask the patient to open and close a fist for an upper extremity injury, and to wiggle their toes and move the foot up and down for a lower extremity injury. Sometimes, an attempt at motion will produce pain at the injury site. If this occurs, do not continue this part of the examination. To avoid causing pain, do not perform this test at all if the injury involves the hand or foot itself.

Sensation: the ability of the patient to sense light touch in the fingers or toes distal to the site of a fracture is a good indication that the nerve supply is intact. In the hand, check the feeling on the pulp of the index finger and thumb, as well as the little finger. In the foot, check the feeling on the pulp of the big toe and on the dorsum of the foot laterally.

Capillary Refill: Note and record the skin color, identifying any pallor or cyanosis. Then apply firm pressure to the tip of the fingernail or toenail, which will cause the skin to blanch (turn white). If normal color does not return within 2 seconds after you release the nail, you can assume that circulation is impaired. This test is typically recommended for use in children, although it can be used in adults as well.

Complications of Splinting:

- ❖ Circulatory compromise from excessive constriction of a limb.
- ❖ Continued bleeding not visible under the splint.
- ❖ Pressure to skin and nerves from inadequate padding.
- ❖ Delayed treatment of life-threatening injuries to prolonged splinting procedures.

Types of Splinting Devices

Splints can be made from various household items such as wood bed boards, Popsicle sticks, doors, etc. In EMS, we have special devices created for the sole purpose of splinting. Types of splinting devices used, fall into one of 3 categories:

- ❖ Rigid Splints: splints providing a firm surface in which to secure the bone to, so as to keep it in straight alignment. Examples are Frac Pac's, and B-Splints.
- ❖ Formable Splints: splints, which will form around a curved or flexed joint, still providing a firm, support surface. Examples are ladder splints, and Sam-Splints.
- ❖ Traction Splints: splints used on upper femur fractures, which apply gentle pull traction to relieve pain and pull bone ends apart to decrease rubbing together. EMS examples are Hare Traction Splints (pulley style) and Sager Traction Splints (ratchet style).

Traction Splinting

Indications for Use:

A Traction Splint should be used to immobilize fractures of the femur, which are characterized by pain, swelling, and deformity of the mid-thigh. Whether a pulley-style or ratchet-style traction device is utilized, the same principles of splinting apply.

Contraindications:

Traction splinting is contraindicated if the injuries to the limb involve injuries to the hip, knee or ankle joints and, or the fracture is within 2.5 to 5.0cm (1-2 inches) of the joint.

Application of a Traction Splint

- ❖ Assess scene safety
- ❖ Take all Routine Practice (BSI) precautions
- ❖ Perform all initial and rapid surveys
- ❖ Expose and manually stabilize limb.
- ❖ Treat wounds as indicated.
- ❖ Assess and record circulatory and neurological status distal to injury.
- ❖ Have the patient lay down flat to facilitate application of splint.
- ❖ Apply manual traction to injured leg by grasping ankle and calf and exerting a gentle pull in the line of the thigh.
- ❖ Maintain a strong steady pull until the patient feels relief
- ❖ Traction must be judged so extension of the injured leg brings it only to the same length as the uninjured leg.
- ❖ Once pain relief is noted, the injured leg can be moved into the line of the body if no other injuries prevent this movement.
- ❖ Traction must be maintained as the traction splint is applied.
- ❖ Care must be taken so that traction is not lost during splint application.
- ❖ Measure and adjust the splint length against the uninjured leg and make all other preparations for applying it.
- ❖ Monitor the traction splint during transport and any movement of the patient.

Application of Pulley-Style (Hare) Traction Splints

- ❖ Employ the basic principles outlined above
- ❖ Position the splint under the hip against the ischium and secure it in place with the ischial strap
- ❖ Place padding under the ischial strap if required
- ❖ Leg may be gently elevated sufficiently for the splint to be applied
- ❖ Alternately, the patient may be gently rolled to the uninjured side to allow the splint to be positioned.
- ❖ Attach the ankle hitch to the traction splint
- ❖ Apply mechanical traction with no loss of manual traction until all of the manual traction is taken up
- ❖ Secure the leg in the splint
- ❖ Reassess and record distal circulatory and neurological status



Application of Ratchet-Style (Sager) Traction Splint

- ❖ Employ the basic principles outlined above
- ❖ Position the splint appropriately
- ❖ Apply the ischial strap at an angle towards the lateral hip joint and secure the strap in place
- ❖ Place padding under the ischial strap if required
- ❖ Apply mechanical traction with no loss of manual traction until all of the manual traction is taken up to the relief of pain or 10% of the patients body weight
- ❖ Secure the leg in the splint
- ❖ Reassess and record distal circulatory and neurological status

Traction Splints- Hare, Sager, and Thomas respectively



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