UNITED STATES MARINE CORPS

FIELD MEDICAL TRAINING BATTALION
Camp Lejeune, NC 28542-0042

FMST 409

Manage Musculoskeletal Injuries

TERMINAL LEARNING OBJECTIVE

1 . Given a casualty in an operational environment, standard field medical equipment and supplies, **treat musculoskeletal injuries** to reduce the risk of further injury or death. (8404-MED-2004)

ENABLING LEARNING OBJECTIVES

1 . Without the aid of reference, given a description or list, **identify the anatomy of the musculoskeletal system**, within 80% accuracy per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2004a)

2 . Without the aid of reference, given a description or list, **identify the management of soft tissue injuries**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2004b)

3 . Without the aid of reference, given a description or list, **identify the management of fractures**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2004c)

4 . Without the aid of reference, given a description or list, **identify the principles of splinting**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2004d)

5 . Without the aid of reference, given a simulated casualty with musculoskeletal injuries and a Corpsman Assault Pack, **manage the simulated casualty**, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2004e)

1. **ANATOMY OF THE MUSCULOSKELETAL SYSTEM**

Understanding the gross anatomy and physiology of the human body is the foundation on which assessment and management are based. Without a good grasp of the structures of the bones and muscles, one will not be able to relate kinematics and superficial injuries to injuries that are internal.

Skeletal System – the mature human body has approximately 206 bones separated into categories by shape.

Long bones – femur, humerus, ulna, radius, tibia and fibula

Short bones – metacarpals, metatarsals and phalanges

Flat bones – sternum, ribs and scapulas

Sutural bones – variable and irregularly shaped bones in the sutures between the bones of the skull

Sesamoid bones - located within tendons; patella is the largest

What happended to the "irregular bones"

- This is a more generalized category that contains bones that do not fall into the long, short or flat classification.

Muscular System – the human body has more than 700 individual muscles, which are categorized by function. (See Figure 1)

Skeletal (voluntary) – muscle fiber is striated, or striped, and is under the control of the individual's will. Skeletal muscle tissues are usually attached to bones. When muscle fibers are stimulated by an action of a nerve fiber, the fibers contract and relax. This interaction between muscle and nervous fibers produces movement.

Smooth (involuntary) – muscle fibers are smooth, or non-striated, and are not under the control of the individual's will. Smooth muscle tissue is found in the walls of hollow organs, such as the stomach, intestines, blood vessels, and urinary bladder. Smooth muscle tissues are responsible for the movement of food through the digestive system, constricting blood vessels, and emptying the bladder.

Cardiac – muscle cells are striated and are joined end to end, resulting in a complex network of interlocking cells. Cardiac muscles are involuntary muscles and are located only in the heart. These tissues are responsible for pumping blood through the heart chambers and into certain blood vessels.

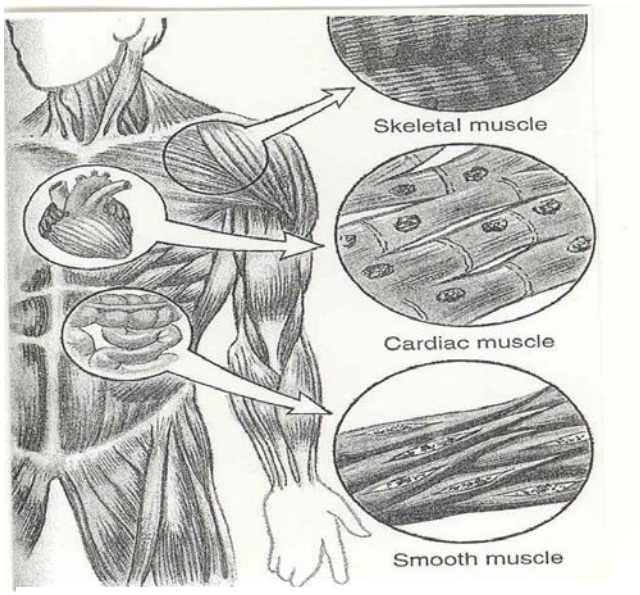

Figure 1. Three Types of Muscles

Osseous Connective Tissue – this type of tissue, known as "bone tissue" is dense fibrous connective tissue that forms tendons, ligaments, cartilage, and bones. These tissues form the supporting framework of the body. (See Figure 2)

Tendon – a band of tough, inelastic, fibrous tissue that connects a muscle to a bone

Ligament – a band of tough, fibrous tissue connecting bone to joint

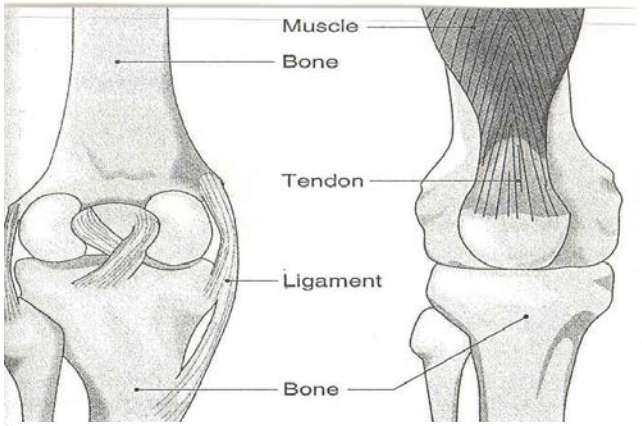

Figure 2. Osseous Connective Tissue

2. MANAGEMENT OF SOFT TISSUE INJURIES

Causes of Wounds (Kinematics of Trauma) – Although it is not always necessary to know what agent or object has caused the wound, it is helpful. Of special concern in wartime setting is the velocity of wound-causing missiles (bullets or shrapnel). A low-velocity missile damages only the tissues with which it comes into contact. On the other hand, a high-velocity missile can do enormous damage by forcing the tissues and body parts away from the track of the missile with a velocity only slightly less than that of the missile itself. These tissues, especially bone, may become damage-causing missiles themselves, thus accentuating the destructive effects of the missile.

Having classified the wound into one or more of the general categories listed, the FMST will have a good idea of the nature and extent of the injury, along with any special complications that may exist. This information will aid in the treatment of the casualty.

Open Soft Tissue Injuries – an injury in which the skin is interrupted, or broken, exposing the tissues underneath.

Abrasions – Occur when skin is rubbed or scrapped off. (See Figure 3)

Treatment:

- Hemorrhage is usually so minimal that primary treatment may only require cleansing of the wound.
- Small bandages may be applied, but tactical situations will usually preclude applying field dressings that are needed for more serious injuries.
- A large amount of dirt may be ground into the wound, therefore secondary treatment measures should focus on preventing or stopping infections.

Figure 3. Abrasion

Lacerations – Torn skin with ragged irregular edges and masses of torn tissue underneath. (See Figure 4)

Figure 4. Laceration

Treatment:

- Generally the same as for abrasions
- Control hemmorhage
- If major tendons and muscles are completely severed, immobilize limb to prevent further damage.
- Treat for shock

Avulsion - An injury in which flaps of skin are torn loose or completely pulled off. (See Figure 5)

Treatment

Figure 5. Avulsion

- Control bleeding
- Apply field dressing to avulsed area.
- Prevent further contamination
- Ensure avulsed flap is lying flat and that it is aligned in its normal position.
- Make every effort to preserve the avulsed part (wrap the part in a saline or water soaked field dressing, pack wrapped part in ice, whenever possible. Be careful to avoid direct contact between the tissue and ice.)
- Transport the avulsed part with the patient, but keep it well protected from further damage and out of view of the patient.
- Immobilize extremity or body part as indicated by the severity of the avulsion.

Traumatic Amputations - Non-surgical removal of a limb or other appendage of the body. Because blood vessels are elastic they tend to spasm and retract into surrounding

tissue. With complete amputations there is less bleeding then with partial or degloving cases. (See Figure 6)

Figure 6. Traumatic Amputation

Treatment

- If life-threatening bleeding is present, apply a tourniquet immediately
- If there is non life-threatening bleeding, a pressure dressing may be used. More than one may be necessary to gain control of bleeding.
- Make every effort to preserve the amputation.
- Wrap amputated part in sterile dressing, place in ice and send with patient
- TACEVAC

Closed Soft Tissue Injuries – An injury where there is no open pathway from the outside to the injured site. Examples include strains, sprains and dislocations.

Strain - Injury to a muscle or tendon resulting from over stretching or over exertion. The chief symptoms of a strain are pain, lameness or stiffness moderate swelling at the place of injury, discoloration due to the escape of blood from injured blood vessels into the tissues, possible loss of power, and a distinct gap felt at the site.

Treatment

- Supportive strapping or bandaging
- Immobilize by splinting so that affected muscle is in relaxed position, if injury is severe.
- R.I.C.E. (Rest, Ice, Compression, Elevation)

Sprain - A joint injury resulting in partial tearing or stretching of supporting ligaments. Symptoms of a sprain include pain or pressure at the joint, pain upon movement, swelling and tenderness, possible loss of movement, and discoloration. Treat all sprains as fractures until ruled out by X-rays. (See Figure 7)

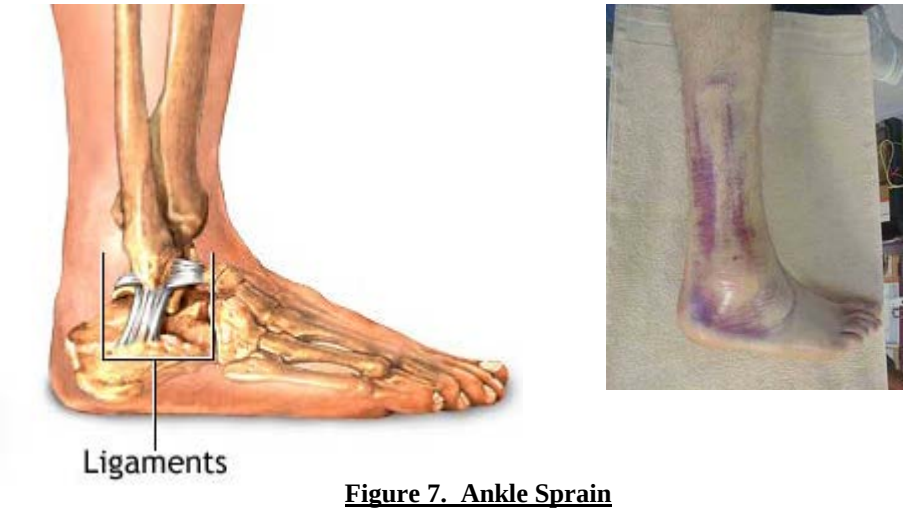

Figure 7. Ankle Sprain

Treatment

- Treat like a fracture
- Supportive strapping or bandaging
- R.I.C.E. (Rest, Ice, Compression, Elevation)
- Pain management
- TACEVAC

Dislocation - When a bone is forcibly displaced from its joint. In some cases, the bone slips back quickly into its normal position, but at other times it becomes locked in the new position and remains dislocated until it is put back into place. A dislocation is likely to bruise or tear the muscles, ligaments, blood vessels, tendons, and nerves near a joint. Rapid swelling and discoloration, loss of ability to use the joint, severe pain and muscle spasms, possible numbness and loss of pulse below the joint, and shock are characteristic symptoms of dislocations. (See Figure 8)

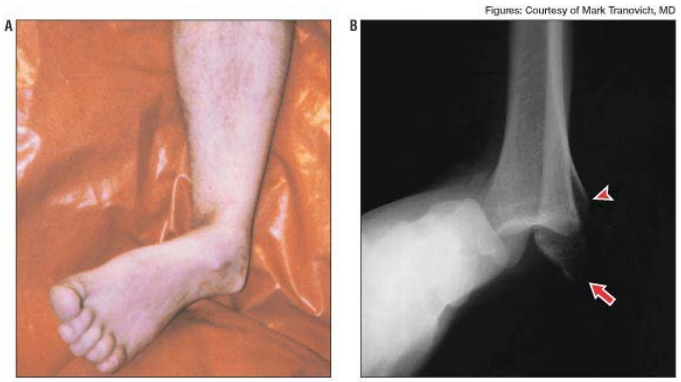

FIGURE 1. Photo (A) of the left ankle of a 33-year-old male recreational softball player shows tibiotalar dislocation of the ankle. The foot is displaced medially, and the skin is tented over the prominence of the lateral malleolus. Anterolateral radiograph of the same ankle (B) shows that the talus is completely disassociated from the ankle mortise (arrow), and a small avulsion of the fibula is evident (arrowhead).

Figure 8. Dislocation

Treatment

- Attempt to reduce only if no pulse is present in the extremity
- Splint as found to immobilize injured part
- Pain management
- Treat for shock
- TACEVAC

Complications

- Hemorrhage caused by seperated bone ends tearing muscle tissue and laceration of blood vessels.

- Nerve damage due to the cutting or pinching of nerves by seperated bone ends or muscle injury.

3. **MANAGEMENT OF FRACTURES**

TYPES OF FRACTURES

Figure 9. Open Fracture

Open Fracture – A broken bone that breaks the overlying skin. The bone may protude through the skin. (See Figure 9) Penetrating objects such as bullets may go through the flesh and break the bone.

Closed Fracture - A broken bone with no skin penetration. The tissue beneath the skin may be damaged. (See Figure 10)

SIGNS AND SYMPTOMS OF FRACTURES

Inability to move the extremity
Discoloration
Deformity
Edema
Pain with or without movement
Protruding bone
Crepitus (crunching, grating sound/feeling)
Any injury that may indicate fracture (i.e. gun shot wound)

Figure 10. Closed Fracture

GENERAL TREATMENT FOR FRACTURES – The following guidelines can be applied to any type of fracture, regardless of location.

Control hemorrhage
Treat for shock
Check distal pulses before and after splinting
Immobilize the fracture using splints
Recheck PMS
Relieve pain (whenever possible)
Reductions of fractures are not done in the field, unless distal pulses are not present
Document treatment
Monitor and TACEVAC

4. **PRINCIPLES OF SPLINTING**

TYPES OF SPLINTS – Splints are used to immobilize a portion of the body, prevent further damage and alleviate pain.

Rigid Splints – cannot be changed in shape. The injured body part must be positioned to fit the splint. Examples include board splints made of wood, plastic, or metal.

Formable Splints - Formable splints can be molded into various shapes and combinations to accommodate the shape of the injured extremity. Examples include

vacuum splints, pillows, blankets, cardboard splints, SAM splints and wire ladder splints. (See Figure 11)

Figure 11. SAM Splint

Improvised Splints – Improvised splints are made from any available material that can be used to stabilize a fracture. Examples include sticks, branches and poles.

Anatomical Splints - Use of the casualty's body as a splint. Examples include securing the legs together, securing the arm to the body, and taping the fingers together. (See Figure 14)

Figure 12. Anatomical Splint

Manufactured Splints – Designed for specific injuries and specific applications. Examples include the traction splint and pneumatic air splints. (See Figures 13 and 14)

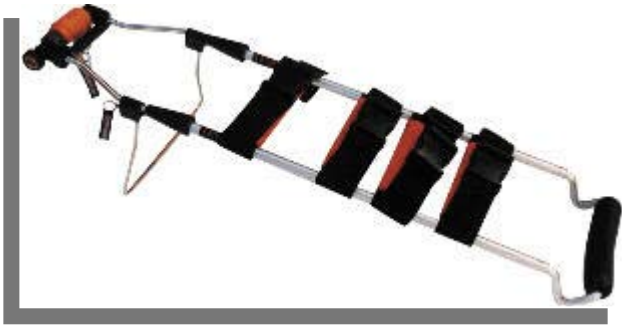

Figure 13. Traction Splint

Figure 14. Pneumatic Air Splint

Bandages in Splinting - Bandages can be used to wrap or bind a body part. Bandages hold splints in place, apply additional pressure, and protect the casualty from further harm.

Sling - a bandage suspended from the neck to support an upper extremity. When using a sling, position the hand higher then the elbow and never cover the fingers.

Swathe - Any band or piece of cloth used to further immobilize a fracture.

GENERAL GUIDELINES FOR SPLINTING

Control hemorrhage and treat for shock.
Expose fracture site.
Establish distal pulse prior to splinting.
If bone is exposed, ensure to cover the ends with sterile dressing prior to splinting.
Splint fracture in position found.
Attempt to straighten a deformed limb only if it is a closed injury with no distal pulses.
Do not try to reposition or put back an exposed bone.
Move the fractured part as little as possible while applying the splint.
Immobilize the splint above and below the fracture.
Reassess distal pulses after splint is secured.
When in doubt, treat all injuries as a possible fracture.
TACEVAC as needed.

TECHNIQUES FOR SPLINTING FRACTURES

There are various ways and techniques to immobilize fractures. The FMST must be able to apply the basic splints for the most common fractures:

Fractured Jaw

- Apply a bandage to immobilize jaw (Modified Barton). (See Figure 15).
- The bandage should pull the lower jaw forward
- Support should be on the head, not behind neck.
- Do not lay casualties with lower jaw fractures on their back. Doing so may cause airway obstruction.

Figure 15. Immobilizated Jaw

Fractured Clavicle

- Immobilize using figure eight bandage. (See Figure 16)
- Bend casualty's arm on injured side, forearm across chest.
- Palm should be turned in, thumb pointed up.
- Hand should be raised 4 inches above elbow.
- Support using a cravat to cradle the arm & tie around the body for immobilization (Sling and Swath). (See Figure 17)

Figure 16. Immobilizated Clavicle

Figure 17. Sling and Swathe

Fractured Humerus

- Check for distal pulse
- If fracture is located on the upper arm near shoulder, place padding in the armpit, bandage arm securely to body (See Figure 18).
- If fracture is located in the middle of upper arm, use splint on outside of arm.
- Splint the injury to the body using a full arm wrap (Kerlex or cravat wrap). Support with sling (See Figure 19).
- If fracture is near elbow, splint in position found. Support with sling.
- Re-check distal pulse.

Figure 18. Upper Arm Splint 1

Figure 19. Upper Arm Splint 2

Fractured Forearm

- Check for distal pulse
- If only one bone in the forearm is broken, the other may be used as a splint.
- Apply two splints (rigid or formable), one on top and one on the bottom.
- Ensure that the splints cover from wrist to elbow (rigid or formable splint). (See Figure 20)
- Use bandages to hold splints in place.
- Re-check distal pulse
- Place casualty's forearm across the chest, palm turned in and thumb pointing up
- Support with sling

Figure 20. Forearm Splint

Fracture Wrist/Hand

- Check radial pulse
- Splint in position of function leaving fingers exposed (formable splint). (See Figure 21)
- Re-check radial pulse
- Support with sling

Figure 21. Wrist/Hand Splint

Fractured Ribs

- Assess ABCs for possible complications

- Ordinarily, simple rib fractures are NOT bound, strapped or taped if the victim is reasonably comfortable. They may only require analgesics.

- Multiple fractures may require immobilization by strapping the arm of the injured side to the chest to limit motion.

- Arm should be against the chest, palm flat, thumb up and forearm raised to a 45 degree angle. (See Figure 22)

- Secure arm to chest using swath bandage.

- For multiple fractures, you may attempt to immobilize flail segments using tape. (See Figure 23)

- NEVER encircle the chest with any type of constricting bandage. This will only make breathing more difficult!

Figure 22. Rib Splint

Figure 23. Flail Segments

Fractured Pelvis

- Check distal pulse

- Place patient in position of comfort (legs straight or knees bent)

- Place pillow or padding between the legs to immobilize hip

- Wrap sheet (or poncho) snuggly around pelvis for support

- Tie knees and ankles together for greater stability (Figure 24)

- Re-check distal pulse

Figure 24. Pelvis Splint

Fractured Femur

- Check distal pulse

- Using four (4) cravats to secure injured leg to the uninjured leg (anatomical splint) (See Figure 25)

- Secure thighs together

- Secure another cravat directly above and below the knees

- Using a figure 8 wrap, secure ankles & feet together

- Re-check distal pulse

**NOTE: Consider traction splinting for midshaft fractures.

Figure 25. Femur Splint

Fractured Patella

-Check distal pulse

- Splint in position of comfort

- Place splint underneath the entire leg. Ensure you have padding at least under the knee and ankle.

- Secure splint in four places (See Figure 26):

  Just below knee

  Just above knee

  Around the ankle

  Around the thigh

- Re-check distal pulse

Figure 26. Patellar Splint

Fractured Tibia/Fibula

- Check distal pulses
- If only one bone is broken, the other can act as a splint
- Utilize the stirrup method with the SAMS splint (See Figure 27)
- Apply splint on both sides of tibia and fibula
- Use kerlex bandage to secure splint
- Immobilize from knee to ankle
- Re-check distal pulse

Figure 27. Stirrup Splint

Fractured Ankle/Foot

- Check pedal pulse
- Splint injury (See Figure 28)
- Wearing boots: use figure 8 with a cravat to secure ankles together.
- Without boots: Wrap ankle with a bandage (kerlex), then use a figure 8 wrap with a cravat to secure ankles and feet together.
- Re-check pedal pulse

Figure 28. Ankle/Foot Splint

Spinal Injury - The first priority is to ensure the casualty is in a safe location. Next, the FMST may begin spinal immobilization procedures.

Indications for spinal immobilization:

High speed vehicle crash (>30mph)

Falls from great heights (2-3x body height)

Direct, blunt neck trauma

Blast injury

Spinal Immobilization:

To be effective, the casualty must be immobilized from the head to the pelvis.

Do not block the casualties airway

Use a C-Collar to immobilize the neck

If available secure casualty to a long spine board

If full immobilization is not possible- prevent excessive, unnecessary movement of the casualty.

NOTE*:* Remember to treat all life-threatening injuries first prior to treating fractures. Not all casualties will require evacuation.

CASUALTY ASSESSMENT AND MUSCULOSKELETAL INJURIES

Care Under Fire Phase: If the casualty has a life-threatening hemorrhage, apply a tourniquet. No other musculoskeletal injuries will be treated during this phase of care.

Tactical Field Care Phase: During this phase, you will be required to inspect the casualty for any signs of injury. Don BSI. Complete a head to toe assessment using DCAP-BTLS. Note all musculoskeletal injuries and treat if time permits. Note and treat additional injuries. Determine if vascular access is required (see Tactical Fluid Resuscitation lesson) and give fluids if necessary. If the casualty is able to drink fluids, they should be encouraged to do so. Consider pain medications and give antibiotics if warranted. Reassess all care provided. Document care given, prevent hypothermia, and TACEVAC.

REFERENCE

Prehospital Trauma Life Support, current Military Edition

Musculoskeletal Injuries Review

1. List four examples of long bones.

    1)
    2)
    3)
    4)

2. What is the treatment for an avulsion injury?

3. Explain the definition of a sprain.

4. List four signs/symptons of a fracture.

    1)
    2)
    3)
    4)

5. Describe a formable splint and and example.

6. What are the steps for splinting a fractured tibia or fibula?