UNIT TERMINAL OBJECTIVE

4-9 At the completion of this unit, the paramedic student will be able to integrate pathophysiological principles and the assessment findings to formulate a field impression and implement the treatment plan for the patient with a musculoskeletal injury.

COGNITIVE OBJECTIVE

At the completion of this unit, the paramedic student will be able to:

4-9.1 Describe the incidence, morbidity, and mortality of musculoskeletal injuries. (C-1)
4-9.2 Discuss the anatomy and physiology of the musculoskeletal system. (C-1)
4-9.3 Predict injuries based on the mechanism of injury, including: (C-3)
1. Direct
2. Indirect
3. Pathologic

4-9.4 Discuss the types of musculoskeletal injuries: (C-1)
a. Fracture (open and closed)
2. Dislocation/ fracture
3. Sprain
4. Strain

4-9.5 Discuss the pathophysiology of musculoskeletal injuries. (C-1)
4-9.6 Discuss the assessment findings associated with musculoskeletal injuries. (C-1)
4-9.7 List the six "P"s of musculoskeletal injury assessment. (C-1)
4-9.8 List the primary signs and symptoms of extremity trauma. (C-1)
4-9.9 List other signs and symptoms that can indicate less obvious extremity injury. (C-1)
4-9.10 Discuss the need for assessment of pulses, motor and sensation before and after splinting. (C-1)
4-9.11 Identify the need for rapid intervention and transport when dealing with musculoskeletal injuries. (C-1)
4-9.12 Discuss the management of musculoskeletal injuries. (C-1)
4-9.13 Discuss the general guidelines for splinting. (C-1)
4-9.14 Explain the benefits of cold application for musculoskeletal injury. (C-1)
4-9.15 Explain the benefits of heat application for musculoskeletal injury. (C-1)
4-9.16 Describe age associated changes in the bones. (C-1)
4-9.17 Discuss the pathophysiology of open and closed fractures. (C-1)
4-9.18 Discuss the relationship between volume of hemorrhage and open or closed fractures. (C-3)
4-9.19 Discuss the assessment findings associated with fractures. (C-1)
4-9.20 Discuss the management of fractures. (C-1)
4-9.21 Discuss the usefulness of the pneumatic anti-shock garment (PASG) in the management of fractures. (C-1)
4-9.22 Describe the special considerations involved in femur fracture management. (C-1)
4-9.23 Discuss the pathophysiology of dislocations. (C-1)
4-9.24 Discuss the assessment findings of dislocations. (C-1)
4-9.25 Discuss the out-of-hospital management of dislocation/ fractures, including splinting and realignment. (C-1)
4-9.26 Explain the importance of manipulating a knee dislocation/ fracture with an absent distal pulse. (C-1)
4-9.27 Describe the procedure for reduction of a shoulder, finger or ankle dislocation/ fracture. (C-1)

4-9.28 Discuss the pathophysiology of sprains. (C-1)
4-9.29 Discuss the assessment findings of sprains. (C-1)
4-9.30 Discuss the management of sprains. (C-1)
4-9.31 Discuss the pathophysiology of strains. (C-1)
4-9.32 Discuss the assessment findings of strains. (C-1)
4-9.33 Discuss the management of strains. (C-1)
4-9.34 Discuss the pathophysiology of a tendon injury. (C-1)
4-9.35 Discuss the assessment findings of tendon injury. (C-1)
4-9.36 Discuss the management of a tendon injury. (C-1)
4-9.37 Integrate the pathophysiological principles to the assessment of a patient with a musculoskeletal injury. (C-3)
4-9.38 Differentiate between musculoskeletal injuries based on the assessment findings and history. (C-3)
4-9.39 Formulate a field impression of a musculoskeletal injury based on the assessment findings. (C-3)
4-9.40 Develop a patient management plan for the musculoskeletal injury based on the field impression. (C-3)

AFFECTIVE OBJECTIVES
At the completion of this unit, the paramedic student will be able to:

4-9.41 Advocate the use of a thorough assessment to determine a working diagnosis and treatment plan for musculoskeletal injuries. (A-3)
4-9.42 Advocate for the use of pain management in the treatment of musculoskeletal injuries. (A-3)

PSYCHOMOTOR OBJECTIVES
At the completion of this unit, the paramedic student will be able to:

4-9.43 Demonstrate a clinical assessment to determine the proper treatment plan for a patient with a suspected musculoskeletal injury. (P-1)
4-9.44 Demonstrate the proper use of fixation, soft and traction splints for a patient with a suspected fracture. (P-1)

DECLARATIVE

I. Introduction
  A. Epidemiology
    1. Incidence
      a. 70-80% of polytrauma patients suffer musculoskeletal injuries
      b. Blunt trauma
      c. Penetrating trauma
    2. Mortality/ morbidity
      a. Upper extremity injury
        (1) Contribute to long-term impairment
        (2) Rarely life-threatening
      b. Lower extremity injury
        (1) Associated with higher magnitudes of injury
        (2) More significant blood loss
        (3) More difficult to manage in polytrauma patient
        (4) Femur and pelvic injuries may constitute life threats
    3. Risk factors
    4. Prevention strategies
      a. Proper sports training
      b. Wearing seat belts
      c. Child safety seats
      d. Airbags
      e. Gun safety and education
      f. Motorcycle driver education
      g. Fall prevention
      h. Highrise window guards
      i. Other means of preventing musculoskeletal trauma
    5. Review of musculoskeletal anatomy
      a. Skin
        (1) Layer
        (2) Thickness
      b. Subcutaneous
        (1) Fat
        (2) Fascia
      c. General breakdown of the skeletal system
        (1) Axial skeleton
          (a) Forms the central (longitudinal) axis of the body, includes the following bones
            i) Skull
            ii) Vertebral column
            iii) Bony thorax
          (b) Appendicular skeleton
          (c) Pectoral girdle - bones that attach the upper limbs to the axial skeleton

i) Clavicle
ii) Scapula

(d) Pelvic girdle - consists of the paired bones of the pelvis that attach the lower limbs to the axial skeleton, and the sacrum

(2) Vessels
- (a) Arteries
  - i) Axillary
  - ii) Brachial
  - iii) Radial
  - iv) Ulnar
  - v) Hand arcade
  - vi) Digital
  - vii) Femoral
  - viii) Popliteal
  - ix) Dorsalis pedis
  - x) Posterior tibial
  - xi) Anterior tibial
  - xii) Foot arcade
  - xiii) Digital

(3) Muscles
- (a) Latissimus dorsae
- (b) Trapezius
- (c) Rhomboids
- (d) Deltoid
- (e) Triceps
- (f) Biceps
- (g) Forearm extensors
- (h) Intrinsic muscles of hand
- (i) Hamstring group
- (j) Quadriceps group
- (k) Adductor group
- (l) Gastrocenemius solius
- (m) Intraosseos

(4) Tendons
- (a) Extensors
- (b) Flexors

(5) Bones
- (a) Components of a longbone
  - i) Diaphysis
    - a) Long, narrow shaft
    - b) Very dense, compact bone
    - c) Yellow bone marrow that stores fat
  - ii) Periosteum
    - a) Outer covering for long bones
    - b) Vascular and full of nerves

c) Haversian canals allow circulation of blood
iii) Epiphysis
a) Articulated, widened end
b) Cancellous bone filled with red blood marrow
c) Responsible for growth in the infant and child
d) Weakest point in a child's bone and weaker than a child's ligaments
iv) Metaphysis
a) Area between the epiphysis and diaphysis

(6) Scapulae
(a) Upper division
(b) Lower division
(c) Glenoid fossa

(7) Clavicle
(a) Claviclulo-sternal joint
(b) Acromio-clavicular joint

(8) Humerus
(a) Head
i) Anatomical neck
ii) Surgical neck
(b) Tuberosities
(c) Shoulder joint
(d) Neck
(e) Shaft
(f) Medial condyle
(g) Lateral condyle
(h) Elbow

(9) Radius
(a) Elbow
(b) Head
(c) Shaft
(d) Wrist

(10) Ulna
(a) Elbow
(b) Olecranon
(c) Shaft
(d) Wrist

(11) Carpals
(a) Articulation
(b) Wrist
(c) Metacarpal joint

(12) Metacarpals
(a) Articulations
(b) Shaft

(13) Phalanges

(a) Metacarpal-phalange joint
(b) Proximal intraphalange joint
(c) Distal intraphalange joint

(14) Pelvis
(a) Ilium
(b) Ischium
(c) Pubis
(d) Acetabulum

(15) Femur
(a) Hip joint
(b) Head
(c) Neck
(d) Trochanters
i) Greater trochanter
ii) Lesser trochanter
(e) Shaft
(f) Medial and lateral condyles

(16) Tibia
(a) Knee joint
(b) Articular surfaces/ plateaus
(c) Shaft
(d) Medial malleolus

(17) Fibula
(a) Head
(b) Shaft
(c) Lateral malleolus

(18) Talus
(a) Ankle joint
(b) Articulation

(19) Calcaneus
(a) Heel
(b) Articulation

(20) Tarsals
(a) Articulations
(b) Arch

(21) Metatarsal
(a) Arch
(b) Articulations

(22) Phalanges
(a) Shaft
(b) Joints

d. Function
(1) Flexion
(2) Extension
(3) Rotation

e. Age associated changes in bones
   (1) Morphological changes
      (a) Water content of intervertebral disks decreases
      (b) Increased risk of disk herniation
      (c) Loss of ½ to 3/4 inch in stature is common
      (d) Bone tissue disorders shorten the trunk
      (e) Vertebral column gradually assumes an arc shape
      (f) Costal cartilages ossify making the thorax more rigid
      (g) Shallow breathing due to rigid thoracic cage
      (h) Facial contours change
   (2) Fractures
      (a) Bones are more prone to fracture since they are more porous and brittle
      (b) Vertebral and femoral neck fractures are most common
      (c) Degree of bone disorder (osteoporosis) is related to incidence of fracture

6. Physiology
   a. Purpose of the muscles
      (1) Cardiac muscle
         (a) Contracts rhythmically on its own
         (b) Generates electrical impulses
            i) Automaticity
            ii) Excitability
            iii) Conductivity
      (2) Smooth muscle
         (a) Found in lower airways, blood vessels, intestines
         (b) Under control of automatic nervous system
         (c) Can relax or contract to alter the inner lumen diameter
      (3) Skeletal muscle
         (a) Under conscious control
         (b) Major muscle mass of the body, allows mobility
   b. Muscular support of skeleton
      (1) Tendons
         (a) Bands of connective tissue binding muscles to bones (M-T-B)
         (b) Allows for power of movement across the joints
      (2) Cartilage
         (a) Connective tissue covering the epiphysis
         (b) Act as surface for articulation
         (c) Allow for smooth movement at joints
      (3) Ligaments
         (a) Connective tissue which support joints
         (b) Attach to bone ends
         (c) Allow for stable range of motion
   c. Purpose of the bones
      (1) Acts as a structural form, protects vital organs

(2) Acts as point of attachment for tendons, cartilage, and ligaments
(3) Structure for muscles to allow movement
(4) Stores salts and metabolic materials
(5) Produces red blood cells

d. Structural classifications of joints
(1) Fibrous
(a) Sutures - immovable
i) An immovable joint with one exception
ii) All bones of the skull are united by sutures
(b) Syndesmoses
(c) Gomphoses
(2) Cartilaginous
(a) Defined
(b) Synchondroses
(c) Symphysis
(3) Synovial
(a) Defined - fluid filled chamber which lubricates articulated surfaces
(b) Types of synovial joints
i) Plane
ii) Hinge
iii) Pivot
iv) Condyloid
v) Saddle
vi) Ball and socket

e. Movements allowed by synovial joints
(1) Gliding
(2) Angular movements
(a) Flexion
(b) Extension
(c) Abduction
(d) Adduction
(e) Circumduction
(3) Rotation

f. The interrelationship of the musculoskeletal system working together to move a complex joint (e.g., the knee)

II. Musculoskeletal pathophysiology-adult
A. Problems associated with musculoskeletal injuries
1. Hemorrhage
2. Instability
3. Loss of tissue
4. Simple lacerations and contamination
5. Interruption of blood supply
6. Long term disability

B. Fractures
  1. Types
    a. Open (compound)
    b. Closed (simple)
  2. Location
    a. Humerus
    b. Radius
      (1) Silver fork deformity
    c. Ulna
    d. Metacarpal
    e. Phalange
    f. Pelvis
      (1) Complications
        (a) Hemorrhage
        (b) Associated organs
        (c) Pregnancy complications
        (d) Associated dislocations
    g. Femur
      (1) Head
      (2) Neck
      (3) Intertrochanteric
      (4) Subtrochanteric
      (5) Shaft
      (6) Condylar
      (7) Supra condylar
    h. Tibia
      (1) Plateau
      (2) Shaft
      (3) Ankle
    i. Fibula
      (1) Shaft
      (2) Isolated
      (3) Ankle
    j. Ankle
      (1) Dislocation/ fracture
      (2) Malleal fracture
      (3) Tri malleolar
    k. Foot
      (1) Calcanei
      (2) March fracture
      (3) Meta tarsal dislocation
      (4) Phalanges
  3. X-ray descriptions of fractures
    a. Greenstick
    b. Oblique

c. Transverse
d. Comminuted
e. Spiral
f. Impacted
g. Epiphyseal fractures (in children)

C. Relate kinematics to the following injuries
1. Open fractures - break where protruding bone causes a soft tissue injury
a. Some bones are very close to the surface - reach down and touch your shin
b. EMS objective not to turn a closed fracture into an open fracture
2. Closed fractures - break in the bone which has not yet penetrated the soft tissue
a. May not be as obvious, yet serious potential for other injuries
3. Comminuted fractures - a break which involves several breaks in the bone causing bone fragment damage; consider the combined blood loss and potential for other injuries
4. Greenstick fractures - a bone break in which the bone is bent but only broken on the outside of the bend; children are most likely to have these
5. Spiral fracture - a bone break caused by a twisting motion
6. Oblique fracture - a bone break at a slanting angle across the bone
7. Transverse fracture - a broken bone that occurs at right angles to the long part of the bone involved
8. Dislocations - a bone moved from its normal position at a joint and may have associated fractures
9. Sprains - an injury to the tendons, muscles or ligaments around a joint, marked by pain, swelling, and dislocation of the skin over the joint
10. Strains - damage, usually muscular, that results from excessive physical effort
11. Joint injury - may be a fracture, dislocation or sprain
12. Stress fracture - a bone break, especially one or more of the foot bones, caused by repeated, long-term, or abnormal stress

D. Pathological fractures
E. Vascular injuries
F. Dislocations and subluxations
1. Subluxation
a. Partial dislocation of a joint with great damage and instability
2. Luxation
a. Complete dislocation of a joint
3. Dislocation
a. Frank displacement of bone ends at the joint
4. Specific injuries
a. Acromio clavicular
b. Shoulder
c. Elbow
d. Wrist
e. Metacarpal-phalange
f. Phalange
g. Hip
(1) Posterior

(2) Anterior
(3) Associated with fracture
h. Knee
(1) Posterior
(2) Anterior
(3) Patella
i. Ankle
(1) Posterior
(2) Fracture association
j. Foot
k. Hand

G. Lacerations
1. Protection
2. Hemostasis
3. Dressing

H. Hematoma

I. Sprains and strains
1. Sprain
a. Tearing of the ligaments surrounding a joint
b. Grades
(1) Grade I
(2) Grade II
(3) Grade III
(4) Repeated Grade I sprains can result in ligamentous stretching
(5) Grade III sprains can present the same as a fracture
2. Strain
a. Overstretching of a muscle or tendon
b. Examples

J. Typical blood loss in an uncomplicated fracture during the first two hours
1. Tibia/ fibula - 550 ml
2. Femur - 1000 ml
3. Pelvis - 2000 ml

K. Complications associated with fractures
1. Can exsanguinate from a fracture involving an artery laceration (e.g., femoral)
2. Major blood loss can occur at the beak point
3. Decreased distal pulse
4. Diminished distal sensory or motor function
5. Crushing injury
6. Amputation/ avulsion

L. Inflammatory and degenerative conditions
1. Bursitis and tendinitis
2. Arthritis
a. Osteoarthritis
b. Rheumatoid arthritis
c. Gouty arthritis

III. Musculoskeletal assessment
- A. Four classes of patients with musculoskeletal trauma
  1. Patients with life/ limb-threatening injuries or conditions, including life/ limb-threatening musculoskeletal trauma
  2. Patients with other life/ limb-threatening injuries and only simple musculoskeletal trauma
  3. Patients with life/ limb-threatening musculoskeletal trauma and no other life/ limb-threatening injuries
  4. Patients with only isolated, non-life/ limb-threatening injuries
- B. Conduct the initial survey first to determine if there are any life-threats
  1. Care for life-threatening conditions first
  2. Never overlook life/ limb-threatening musculoskeletal trauma
  3. Never allow a horrible looking, but noncritical musculoskeletal injury to distract you
- C. The six "p"s of musculoskeletal assessment
  1. Pain
     a. Pain on palpation (tenderness)
     b. Pain upon movement
  2. Pallor - pale skin or poor capillary refill
  3. Paresthesia - pins and needles sensation
  4. Pulses - diminished or absent
  5. Paralysis - inability to move
  6. Pressure
- D. Assessment of musculoskeletal injury
  1. General findings - inspect and palpate DCAP-BTLS
     a. Deformity
     b. Contusions
     c. Abrasions
     d. Penetrations or punctures
     e. Burns
     f. Tenderness
     g. Lacerations
     h. Swelling
  2. Specific findings - inspect and palpate
     a. Position found
     b. Hematoma
     c. Dislocation
     d. Cyanosis
     e. Motion - reduced or abnormally enlarged range
     f. Bleeding
     g. Guarding or self-splinting
     h. Crepitus
- E. Assessment findings - palpation
  1. Tenderness or pain
  2. Deformation
  3. Crepitation

4. Swelling/ skin tension
5. Pulses
6. Capillary refilling
7. Innervation

F. Special sports considerations
1. Mechanism of injury
   a. Football
   b. Basketball
   c. In-line skating
   d. Skiing or snow boarding
   e. Wrestling
   f. Soccer
   g. Rock climbing
2. Special sports injuries
   a. Shoulder
   b. Elbow
   c. Wrist
   d. Clavicle
   e. Knee
   f. Ankle
   g. Foot
   h. Tibia/ fibula
3. Interfacing with athletic trainers

IV. Management
A. General principles
1. Splint joint above and below as well as bone ends
2. Immobilize open and closed fracture the same
3. Cover open fracture to minimize contamination
4. Check pulses, sensation, and motor function before and after splinting
5. Stabilize with gentle in-line traction to position of normal alignment
6. Immobilize where they are found not in the exact position the limb is found
   a. It makes most sense to move a long bone injury into a “splintable” straight position
   b. Joint injuries are only moved if there is no distal pulse
7. Immobilize dislocation/ fractures in position of comfort and good vascular supply
8. Immobilize joints as found
9. Application of cold
   a. Reduce swelling
   b. Reduce pain
10. Compression
11. Elevation of extremities

B. Splints - rigid, formable, traction
1. Cardboard
2. Wood

3. Air
4. Traction
    a. History
    b. Principle
    c. Types
        (1) Unipolar
        (2) Bipolar
5. Vacuum
6. Pillow/ blanket
7. Short spinal immobilization devices
    a. Refer to spinal injury section
8. Long spinal immobilization devices
    a. Ultimate body splint
    b. Refer to spinal injury section

C. Dislocation/ fractures
1. Realignment
    a. Typically dislocated joints should be immobilized in the position of injury and transported for reduction
    b. Delayed or prolonged transport requires a different approach
    c. An attempt to reposition any dislocated joint into anatomical position should be made if distal circulation is impaired and if transportation is long or prolonged
    d. Check circulation and nerve function before and after any manipulation of any injured bone or joint
    e. Discontinue an attempt at repositioning if
        (1) Pain is increased significantly by manipulation, and/ or
        (2) Resistance to movement is encountered
2. Limb-threatening injuries
    a. Knee dislocation/ fracture
    b. Dislocation/ fracture of the ankle
    c. Subcondular fractures of the elbow
3. Always assess pulses, sensation, and motor function before and after manipulating the injury
4. Specific techniques for specific joints
    a. Finger realignment
    b. Hip realignment
        (1) One attempt if there is severe neurovascular compromise
        (2) As soon as possible after the injury
        (3) Do not attempt if associated with other severe injuries
        (4) Analgesics
        (5) Procedure
            (a) Traction
            (b) Hip 90 degrees
            (c) Knee 90 degrees
            (d) Along shaft of femur
            (e) Steady and slow to relax muscle spasm

(f) Success
i) "Pop" into joint
ii) Sudden relief of pain
iii) Leg can easily and painlessly be returned to full extension
(g) Immobilization, full extension, long backboard, reevaluation of pulses and innervation
(h) Immobilization, comfortable flexion not to exceed 90 degrees, pillows, chair, cardboard, supine position of patient

c. Knee realignment - do not confuse with a patella dislocation, this is a limb-threatening injury
(1) One attempt if there is severe neurovascular compromise
(2) As soon as possible after the injury
(3) An attempt to reposition a dislocation of the knee into anatomical position should be made if transport time is delayed or prolonged greater than two hours, even if distal circulation is normal
(4) Do not attempt if associated with other severe injuries
(5) Analgesics
(6) Procedure
(a) Apply gentle and steady traction and then move the injured joint into normal position
(b) Full extension
(c) Steady pull to relax muscle spasm
(d) Success
i) "Pop" into joint
ii) Loss of deformity
iii) Relief of pain
iv) Knee is now more mobile
(e) Immobilization, full extension, backboard, long board splints, no traction, assess pulses, position of greatest comfort, slight flexion

d. Ankle realignment
(1) One attempt if there is severe neurovascular compromise
(2) As soon as possible after the injury
(3) Do not attempt if associated with other severe injuries
(4) Analgesic
(5) Procedure
(a) Pull traction on the talus while stabilizing the tibia
(b) Slow and steady to relax spasm
(c) Success, sudden rotation to normal position
(d) Immobilization, as per fracture, check distal pulse

e. Shoulder realignment
(1) One attempt if there is severe neurovascular compromise
(2) As soon as possible after the injury
(3) Do not attempt if associated with other severe injuries or back injuries
(4) Analgesic

(5) Procedure
(a) Pull traction in the anatomical position only

D. Specific fracture pointers and immobilization techniques
1. Pelvis
a. Backboard and PASG
b. Treat the hypoperfusion as pelvic fractures cause severe hemorrhage, losing greater than 2 liters of blood into the pelvic cavity
2. Femur
a. Traction splinting procedure
(1) Direct manual stabilization of the injured leg
(2) Assess distal motor ability, sensory response, and circulation
(3) Rule out any contraindication to traction splinting
(4) Direct application of manual traction if elevating the leg from the ground
(5) Adjust and position splint at the injured leg
(6) Apply proximal securing device (e.g., ischial strap)
(7) Apply distal securing device (e.g., ankle hitch)
(8) Apply mechanical traction
(9) Position and secure support straps
(10) Re-evaluate the proximal/ distal circulation
(11) Reassess distal motor ability, sensory response, and circulation
(12) Secure patient's torso and traction splint to long backboard for transport
b. PASG and long backboard
c. Long backboard and long board splints
d. Opposite extremity and long backboard
e. Fractures of the proximal femur present similar to the anterior hip dislocation
f. Midshaft or distal femur fractures can have soft tissue, vascular and nerve damage
3. Tibia/ fibula
a. Pneumatic splint
b. Long board splint procedure
(1) Take body substance isolation
(2) Direct application of manual stabilization
(3) Assess distal motor ability, sensory response, and circulation
(4) Measure splint
(5) Apply splint
(6) Immobilize joints above and below the injury site
(7) Secure the entire injured extremity in a distal to proximal direction
(8) Immobilize hand/ foot in the position of function
(9) Reassess distal motor ability, sensory response, and circulation
c. Splinting to the opposite leg
d. Cardboard
4. Ankle - same as tibia/ fibula fractures, generally involves the distal tibia and fibula
a. Pillow splint and leg immobilization
b. Air splint
5. Foot

a. Pneumatic
b. Cardboard
c. Ladder splint

6. Shoulder dislocation/ fracture
   a. Anterior - arm close to the chest and hollow shoulder
   b. Posterior - arm may be over the head
   c. Splinting - be creative, improvise to hold the injury in place (e.g., blanket roll)
      (1) Use a rolled blanket with a cravat through the center
      (2) Position the roll under the elevated arm and secure it like a sling with the cravat through the blanket
      (3) Swathe the arm to prevent upward movement
      (4) If the arm is over the head - splint in position, or pull traction along the long axis of the arm
7. Knee
   a. High incidence of vascular and nerve damage
   b. Any fracture within three inches of a joint should be treated similar to a dislocation
   c. Use triangulation with cravats and two long padded splints
   d. SAM splints are not strong enough for the knee while some ladder splints if properly padded will be effective with immobilization of the hip and ankle
   e. Do not use a traction splint
   f. If found straight use two board splints or cardboard splint
8. Humerus
   a. Difficult to stabilize
   b. Potential for severe circulatory problems
   c. If the patient has a potential neck injury do not tie a sling around the neck
   d. Use a sling and swathe with splints surrounding the humerus or splint with the extremity extended
9. Elbow
   a. High probability for blood vessel and nerve damage
   b. Especially dangerous in children (supracondylar fractures)
   c. Volkman's contracture may result
   d. Padded wire splint and sling and swathe
10. Forearm fracture
    a. May involve radius, ulna, or both
    b. Colle's fracture of the wrist presents with the wrist in a "silver fork" position
    c. Splint like a lower leg fracture described above
11. Hand and wrist fractures
    a. Common with direct trauma
    b. Noticeable deformity
    c. Significant pain
    d. High incidence for nerve and vessel damage
    e. Splint on a padded board splint with the hand in position of function
12. Epiphyseal fractures
    a. Weakest part a child's joint
    b. Presents as a sprain in an adult

c. May result in a permanent angulation or deformed extremities
d. May cause premature arthritis

E. Application of cold/ heat
1. Cold in the first 48 hours to reduce swelling
2. Heat after 48 hour to increase circulation

F. Referral of minor musculoskeletal injuries
1. Evaluate the need for immobilization
2. Evaluate the need for an x-ray
3. Evaluate the need for a physician follow-up visit versus ED visit
4. Contact medical control for advisement

V. Integration