UNIT TERMINAL OBJECTIVE
4-3 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 soft tissue trauma.

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

4-3.1 Describe the incidence, morbidity, and mortality of soft tissue injuries. (C-1)
4-3.2 Describe the layers of the skin, specifically: (C-1)
   a. Epidermis and dermis (cutaneous)
   b. Superficial fascia (subcutaneous)
   c. Deep fascia
4-3.3 Identify the major functions of the integumentary system. (C-1)
4-3.4 Identify the skin tension lines of the body. (C-1)
4-3.5 Predict soft tissue injuries based on mechanism of injury. (C-1)
4-3.6 Discuss the pathophysiology of wound healing, including: (C-1)
   a. Hemostasis
   b. Inflammation phase
   c. Epithelialization
   d. Neovascularization
   e. Collagen synthesis
4-3.7 Discuss the pathophysiology of soft tissue injuries. (C-2)
4-3.8 Differentiate between the following types of closed soft tissue injuries: (C-3)
   a. Contusion
   b. Hematoma
   c. Crush injuries
4-3.9 Discuss the assessment findings associated with closed soft tissue injuries. (C-1)
4-3.10 Discuss the management of a patient with closed soft tissue injuries. (C-2)
4-3.11 Discuss the pathophysiology of open soft tissue injuries. (C-2)
4-3.12 Differentiate between the following types of open soft tissue injuries: (C-3)
   a. Abrasions
   b. Lacerations
   c. Major arterial lacerations
   d. Avulsions
   e. Impaled objects
   f. Amputations
   g. Incisions
   h. Crush injuries
   i. Blast injuries
   j. Penetrations/ punctures
4-3.13 Discuss the incidence, morbidity, and mortality of blast injuries. (C-1)
4-3.14 Predict blast injuries based on mechanism of injury, including: (C-2)
   a. Primary
   b. Secondary
   c. Tertiary
4-3.15 Discuss types of trauma including: (C-1)
   a. Blunt
   b. Penetrating
   c. Barotrauma
4-3.16 Discuss the pathophysiology associated with blast injuries. (C-1)
4-3.17 Discuss the effects of an explosion within an enclosed space on a patient. (C-1)
4-3.18 Discuss the assessment findings associated with blast injuries. (C-1)
4-3.19 Identify the need for rapid intervention and transport of the patient with a blast injury. (C-1)
4-3.20 Discuss the management of a patient with a blast injury. (C-1)
4-3.21 Discuss the incidence, morbidity, and mortality of crush injuries. (C-1)
4-3.22 Define the following conditions: (C-1)
   a. Crush injury
   b. Crush syndrome
   c. Compartment syndrome
4-3.23 Discuss the mechanisms of injury in a crush injury. (C-1)
4-3.24 Discuss the effects of reperfusion and rhabdomyolysis on the body. (C-1)
4-3.25 Discuss the assessment findings associated with crush injuries. (C-1)
4-3.26 Identify the need for rapid intervention and transport of the patient with a crush injury. (C-1)
4-3.27 Discuss the management of a patient with a crush injury. (C-1)
4-3.28 Discuss the pathophysiology of hemorrhage associated with soft tissue injuries, including: (C-2)
   a. Capillary
   b. Venous
   c. Arterial
4-3.29 Discuss the assessment findings associated with open soft tissue injuries. (C-1)
4-3.30 Discuss the assessment of hemorrhage associated with open soft tissue injuries. (C-1)
4-3.31 Differentiate between the various management techniques for hemorrhage control of open soft tissue injuries, including: (C-3)
   a. Direct pressure
   b. Elevation
   c. Pressure dressing
   d. Pressure point
   e. Tourniquet application
4-3.32 Differentiate between the types of injuries requiring the use of an occlusive versus non-occlusive dressing. (C-3)
4-3.33 Identify the need for rapid assessment, intervention and appropriate transport for the patient with a soft tissue injury. (C-2)
4-3.34 Discuss the management of the soft tissue injury patient. (C-2)
4-3.35 Define and discuss the following: (C-1)
   a. Dressings
      1. Sterile
      2. Non-sterile
      3. Occlusive
      4. Non-occlusive
      5. Adherent
      6. Non-adherent
      7. Absorbent
      8. Non-absorbent
      9. Wet
      10. Dry
   b. Bandages
      1. Absorbent
      2. Non-absorbent
      3. Adherent
4. Non-adherent
   c. Tourniquet

4-3.36 Predict the possible complications of an improperly applied dressing, bandage, or tourniquet. (C-2)
4-3.37 Discuss the assessment of wound healing. (C-1)
4-3.38 Discuss the management of wound healing. (C-1)
4-3.39 Discuss the pathophysiology of wound infection. (C-1)
4-3.40 Discuss the assessment of wound infection. (C-1)
4-3.41 Discuss the management of wound infection. (C-1)
4-3.42 Integrate pathophysiological principles to the assessment of a patient with a soft tissue injury. (C-3)
4-3.43 Formulate treatment priorities for patients with soft tissue injuries in conjunction with: (C-3)
   a. Airway/ face/ neck trauma
   b. Thoracic trauma (open/ closed)
   c. Abdominal trauma

4-3.44 Synthesize assessment findings and patient history information to form a field impression for the patient with soft tissue trauma. (C-3)
4-3.45 Develop, execute, and evaluate a treatment plan based on the field impression for the patient with soft tissue trauma. (C-3)

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

4-3.46 Defend the rationale explaining why immediate life-threats must take priority over wound closure. (A-3)
4-3.47 Defend the management regimens for various soft tissue injuries. (A-3)
4-3.48 Defend why immediate life-threatening conditions take priority over soft tissue management. (A-3)
4-3.49 Value the importance of a thorough assessment for patients with soft tissue injuries. (A-3)
4-3.50 Attend to the feelings that the patient with a soft tissue injury may experience. (A-3)
4-3.51 Appreciate the importance of good follow-up care for patients receiving sutures. (A-2)
4-3.52 Understand the value of the written report for soft tissue injuries, in the continuum of patient care. (A-2)

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

4-3.53 Demonstrate the assessment and management of a patient with signs and symptoms of soft tissue injury, including: (P-2)
   a. Contusion
   b. Hematoma
   c. Crushing
   d. Abrasion
   e. Laceration
   f. Avulsion
   g. Amputation
   h. Impaled object
   i. Penetration/ puncture
   j. Blast
DECLARATIVE

I. Introduction
   A. Epidemiology
      1. Incidence
      2. Mortality/ morbidity
      3. Risk factors
      4. Prevention strategies
   B. Body substance isolation review
      1. Risks from exposure to body substances
         a. Bloodborne pathogens
            (1) HIV
            (2) HBV
            (3) Other bloodborne pathogens
         b. Other body substances posing risk
      2. Relationship to body substance isolation
         a. Universal precautions
            (1) Gloves
            (2) Hand washing
            (3) Protective eyewear
            (4) Masks
            (5) Gowns
            (6) Handling and disposal of sharps
         b. Disposal of contaminated materials
   C. Anatomy and physiology review
      1. Layers
         a. Cutaneous layer
            (1) Epidermis
               (a) Stratum germinativum (Basal Layer)
               (b) Stratum corneum
            (2) Dermis
               (a) Fibroblasts
               (b) Macrophages
               (c) Mast cells
               (d) Lymphocytes
               (e) Papillary dermis
               (f) Reticular dermis
         b. Subcutaneous layer (superficial fascia)
            (1) Loose connective tissue
            (2) Fat
               (a) Insulation
               (b) Protection from trauma
         c. Deep fascia
            (1) Thick, dense layer of fibrous tissue
            (2) Support and protect underlying structures
      2. Functions
         a. Protection against mechanical trauma
         b. Regulation of body temperature
         c. Sensory function
            (1) Pain
Trauma: 4

Soft Tissue Trauma: 3

(2) Touch
(3) Heat
(4) Cold
d. Protection against bacterial invasion
e. Maintenance of fluid balance

3. Skin tension lines
   a. Static tension
      (1) Constant force due to taut nature of skin
      (2) Effects on scar formation
      (3) Consideration in wound debridement and revision
      (4) Consideration in foreign body removal
   b. Dynamic tension
      (1) Caused by underlying muscle contraction
      (2) Effects on scar formation
      (3) Consideration in wound debridement and revision
      (4) Consideration in foreign body removal

4. Process of normal wound healing
   a. Hemostasis of wound healing
      (1) Injury causes changes in normal skin anatomy
      (2) Reflex vasoconstriction for up to 10 minutes
      (3) Clotting process begins
   b. Inflammatory phase
      (1) Role of granulocytes
      (2) Role of lymphocytes
      (3) Role of macrophages
   c. Epithelialization phase
      (1) Wound healing within 12 hours
      (2) Healing through re-establishment of skin layers
   d. Neovascularization
      (1) Role of new vessel formation
      (2) Neovascularization as soon as 3 days after, lasting a total of 21 days
      (3) New vessel formation
   e. Collagen synthesis
      (1) Role of fibroblasts in collagen synthesis
      (2) Time factors involved with collagen fibers
      (3) Process of collagen lysis and wound healing
      (4) Time table for the healing and tensile strength of wound

5. Alteration of wound healing
   a. Anatomic factors
      (1) Body region
      (2) Static skin tension
      (3) Dynamic skin tension
      (4) Pigmented skin
      (5) Oily skin
   b. Concurrent drug use
      (1) Corticosteroids
      (2) NSAID
      (3) Penicillin
      (4) Colchicine
      (5) Anticoagulants
(6) Antineoplastic agents

c. Medical conditions and diseases
   (1) Advanced age
   (2) Severe alcoholism
   (3) Acute uremia
   (4) Diabetes
   (5) Hypoxia
   (6) Severe anemia
   (7) PVD
   (8) Malnutrition
   (9) Advanced cancer
   (10) Hepatic failure
   (11) Cardiovascular disease

d. High risk wounds
   (1) Bites (human and animal)
   (2) Foreign bodies
   (3) Wounds contaminated with organic matter
   (4) Injection wounds
   (5) Wounds with significant devitalized tissue
   (6) Crush wounds
   (7) Any wound in immunocompromised patients
   (8) Any wound in patients with poor peripheral circulation

6. Abnormal scar formation
   a. Keloid
      (1) Excessive accumulation of scar tissue that extends beyond original
          wound borders
      (2) More common in darkly pigmented individuals
      (3) Most common locations
          (a) Ears
          (b) Upper extremities
          (c) Lower abdomen
          (d) Sternum
   b. Hypertrophic scar formation
      (1) Excessive accumulation of scar tissue confined within the original wound
          borders
      (2) More common in areas of high tissue stress, such as flexion creases
          across joints
   c. Wounds requiring closure
      (1) Cosmetic regions (face, lip, eyebrow, etc.
      (2) Gaping wounds
      (3) Wounds over tension areas
      (4) Degloving injuries
      (5) Ring injuries
      (6) Skin tearing

II. Pathophysiology and assessment of soft tissue injuries
   A. Identification of closed soft tissue injuries
      1. Contusion
         a. Epidermis remains intact
         b. Cells damaged and blood vessels in dermis are torn
1. Swelling and pain typically present - may occur up to 24 to 48 hours later
   d. Blood accumulation causes ecchymosis

2. Hematoma
   a. Collection of blood beneath skin
   b. Larger amount of tissue damage as compared to contusion
   c. Larger vessels are damaged
   d. May lose one or more liters of blood in confined space

3. Crush injuries
   a. Crushing force applied to body area
   b. Can cause internal organ rupture
   c. Associated with severe fractures
   d. Overlying skin may remain intact, but internal bleeding may be severe, with shock

B. Identification of open soft tissue injuries
   1. Abrasions
      a. Outermost layer of skin is damaged by shearing forces
      b. Painful injury
      c. Superficial
      d. No blood, or very little oozing of blood
         (1) Contamination should be expected

   2. Lacerations
      a. Break in skin of varying depth
      b. May be linear (regular) or stellate (irregular)
      c. Jagged wound ends that bleed freely
      d. May occur in isolation or together with other types of soft tissue injury
      e. Caused by forceful impact with a sharp object
      f. Bleeding may be severe

   3. Incisions
      a. Break in skin of varying depth
      b. Similar to laceration except wound ends are smooth and even, not jagged
      c. Tend to heal better than lacerations
      d. Caused by very sharp objects, such as knife, sharp metal, or scalpel

   4. Avulsion
      a. Flap of skin or tissue torn loose or pulled completely off
      b. Avulsed tissue may or may not be viable

   5. Amputations
      a. Involves the extremities or other body parts
      b. Jagged skin and/ or bone edges are typically present at site of amputation
      c. Massive bleeding may be present or bleeding may be limited
      d. Three types of amputations
         (1) Complete
         (2) Partial
         (3) Degloving

   6. Crush injuries
      a. Causes of injuries
         (1) Collapse of masonry or steel structures
            (a) Earthquakes
            (b) Tornadoes
            (c) Construction accidents
         (2) Collapse of earth

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**Paramedic: National Standard Curriculum**
(a) Mudslides
(b) Earthquakes
(3) Motor vehicle collisions
(4) Warfare injuries
(5) Industrial accidents
(6) Any prolonged compression in a chronic situation
   (a) Unconscious person lying on an extremity
   (b) Prolonged application of PASG
   (c) Improperly applied casts

b. Crush injuries - definitions
(1) Crush injury - injury sustained from a compressive force sufficient to interfere with the normal metabolic function of the involved tissue
(2) Crush syndrome - traumatic rhabdomyolysis; “smiling death”
(3) Systemic manifestations of crush injuries consisting of rhabdomyolysis, electrolyte and acid-base abnormalities, hypovolemia (shock), and acute renal failure
(4) Compartment syndrome - local manifestations of muscle ischemia resulting from compressive forces on a closed space

c. Pathophysiology of crush syndrome
(1) Damage to soft tissue and internal organs
(2) May cause painful, swollen, deformed extremities
(3) External bleeding may be minimal or absent
(4) Internal bleeding may be severe
(5) Reperfusion phenomenon - systemic effects and even microvascular injury occur after the affected tissue is reperfused
(6) Oxygen free radicals
(7) Xanthine oxidase - xanthine oxidase requires two substrates - hypoxanthine and oxygen on reperfusion; oxygen is supplied so xanthine oxidase uses oxygen as an electron acceptor generating the oxygen free radical - oxygen superoxide
(8) Lipid peroxidation - pressure stretch myopathy
(9) High intracellular calcium levels

d. Rhabdomyolysis
(1) Destruction of muscle
(2) Influx from extracellular fluid into muscle cells
   (a) Water
   (b) NaCl
   (c) Ca++
(3) Eflux from muscle to extracellular fluid
   (a) K+
   (b) Purines from disintegrating cell nuclei
   (c) Phosphate
   (d) Lactic acid
   (e) Myoglobin
   (f) Thromboplastin
   (g) Creatine kinase & creatinine
(4) Consequences - all contribute to development of renal failure
   (a) Hypovolemia - adds to cardiotoxicity
   (b) Hypocalcemia - adds to cardiotoxicity
   (c) Hyperkalemia - adds to cardiotoxicity
(d) Hyperuricemia
(e) Hyperphosphatemia
(f) Metabolic acidosis
(g) Possible DIC
(h) Increased levels of serum creatine and creatinine

e. Pathophysiology of compartment syndrome
   (1) Tissue pressure rises above capillary hydrostatic pressure resulting in ischemia to muscle
   (2) Edema of muscle cells develop
   (3) Prolonged ischemia (> 6 to 8 hours) leads to tissue hypoxia and anoxia, and ultimately cell death
   (4) Direct soft tissue trauma adds to the edema and ischemia

f. Renal failure pathogenesis
   (1) Hypovolemia
   (2) Obstructed renal tubules by casts
   (3) Nephrotoxic agents
   (4) Other factors

g. Crush injury clinical presentation
   (1) General
      (a) Alert to unresponsive
      (b) Affected limb may appear almost normal
   (2) Local signs and symptoms
      (a) Flaccid paralysis and sensory loss that are unrelated to peripheral nerve distribution
      (b) May mimic spinal cord injury
      (c) Early - rigor of the joint distal to the involved muscles, wooden texture of the affected skin and muscles, and loss of voluntary muscle contraction
      (d) Varying combinations of pain, swelling, sensory changes, weakness, and pain on passive stretching of muscles
      (e) May have pulses present and warm skin
   (3) Compartment syndrome
      (a) Pain
      (b) Paresthesia
      (c) Paresis
      (d) Pressure
      (e) Passive stretch pain
      (f) Pulselessness

7. Blast injuries
   a. Causes of blast injuries
      (1) Natural gas or gasoline explosions
      (2) Firework explosions
      (3) Dust within a grain elevator
      (4) Terrorism (bombs)
   b. Primary injuries
      (1) Initial air blast
      (2) Compression injuries to air filled organs
         (a) Ruptured ear drum
         (b) Sinuses
         (c) Lungs
(d) Stomach
(e) Intestines

c. Secondary injuries due to flying debris striking victim
d. Tertiary injuries
   (1) Victim is thrown from the blast and strikes an object
   (2) All can lead to superficial and deep internal injuries

8. Punctures/ penetrations
   a. Caused by a foreign object that enters the body
   b. Bleeding is minimal or absent if extremity injury
   c. Bleeding may be severe if abdominal or thoracic injury
   d. Underlying damage can be extensive
      (1) Thoracic
         (a) Simple pneumothorax
         (b) Open pneumothorax
         (c) Tension pneumothorax
         (d) Hemothorax
         (e) Pericardial tamponade
         (f) Penetrating heart wound
         (g) Rupture of esophagus
         (h) Rupture of aorta
         (i) Rupture of diaphragm
         (j) Rupture of mainstem bronchus
      (2) Abdominal
         (a) Solid organ damage
         (b) Hollow organ damage
         (c) Peritonitis
            i) Bacterial
            ii) Chemical
         (d) Evisceration
   e. Increased risk of infection/ complications

9. Impaled objects
   a. Specific type of puncture wound
   b. Instrument that caused injury remains impacted in wound

10. Major arterial lacerations
    a. Any of these injuries can involve major arterial lacerations
    b. Bleeding often will be severe
    c. Spurting, bright red blood flow
    d. Artery may spasm which may decrease blood flow
    e. Can result in shock and death if severe enough blood loss

III. Management principles for soft tissue injuries
A. Treatment priorities
   1. Emphasize scene survey to protect yourself and crew
      a. Have the police ruled out the presence of another bomb or device?
      b. Have the police apprehended the perpetrator?
   2. Treat for hypoperfusion (shock)
   3. Consider the power of the explosion
   4. Internal and external injuries are possible (refer to specific units on specific injuries encountered)
   5. Be aware of possibility of multiple trauma
6. Treatment priorities for patient with a soft tissue injury
   a. Treatment of life-threatening injury should occur prior to isolated soft tissue trauma
      (1) Life-threatening airway deficit
      (2) Life-threatening breathing deficit
      (3) Life-threatening circulatory deficit

7. Methods of hemorrhage control based on injury severity
   a. Direct pressure
      (1) General description
         (a) Quickest/efficient means
      (2) Pressure applied directly to wound
         (a) Dressing and gloved hand
         (b) Gloved hand
      (3) Physiology of intervention
         (a) Limit additional significant blood loss
         (b) Promote localized clotting
      (4) Indications
         (a) Mild hemorrhage
         (b) Profuse hemorrhage
      (5) Contraindications - none
      (6) Assessment of intervention
         (a) Positive hemorrhage control
         (b) Prevention of additional significant blood loss
      (7) Considerations
         (a) Never remove dressing once in place
            i) Restart bleed
            ii) Additional injury
         (b) Positive hemorrhage control
            i) Secure in place with bandage
         (c) Negative hemorrhage control
            i) Continue direct pressure
            ii) Apply additional dressing
            iii) Elevation of extremity with direct pressure
   b. Elevation
      (1) General description
         (a) Used concurrent with direct pressure
         (b) Extremity involvement only
         (c) Elevation of extremity
      (2) Physiology of intervention
         (a) Wound above level of heart
         (b) Gravity decreases blood pressure in extremity
         (c) Slow hemorrhage
         (d) Promote localized clotting
      (3) Indications
         (a) Control of hemorrhage
         (b) Failure of direct pressure to control hemorrhage
      (4) Contraindications
         (a) Possible musculoskeletal injury to involved extremity
         (b) Object impaled in involved extremity
         (c) Possible spinal injury
(5) Assessment of intervention
   (a) Positive hemorrhage control
   (b) Prevention of additional significant blood loss
(6) Considerations
   (a) Positive control - continue elevation
   (b) Negative control
      i) Continue elevation
      ii) Consider pressure dressing

   c. Pressure dressing
      (1) General description
         (a) Dressing firmly wrapped with self adhering roller bandage
         (b) Continuous mechanical pressure
            i) Over injury site
            ii) Above injury site
            iii) Below injury site
      (2) Physiology of intervention
         (a) Limit additional significant blood loss with continuous pressure
         (b) Promote localized clotting
      (3) Indications
         (a) Hemorrhage control
         (b) Failure of other methods to control hemorrhage
            i) Direct pressure
            ii) Elevation
      (4) Contraindications - none
      (5) Assessment of intervention
         (a) Positive control of hemorrhage
         (b) Prevent additional significant blood loss
      (6) Considerations
         (a) Check distal pulse after application
            i) Positive pulse - leave in place
            ii) Negative pulse - adjust to establish circulation
            iii) Some arterial bleeds will stop circulation needed for pulse
         (b) Certain body regions not conducive to direct pressure
         (c) If bleeding continues adjust with more pressure

d. Pressure points
   (1) General description
      (a) Site where main artery lies near surface
      (b) Direct compression applied to site
         i) Brachial artery
         ii) Femoral artery
   (2) Physiology of intervention
      (a) Decrease blood flow to extremity
      (b) Limit additional significant blood loss
      (c) Promote localized clotting
   (3) Indications
      (a) Need for hemorrhage control
      (b) Failure of other methods of hemorrhage control
         i) Direct pressure
         ii) Elevation
iii) Pressure dressings

(4) Contraindications - none

(5) Assessment of intervention
(a) Positive hemorrhage control
(b) Prevention of additional significant blood loss

(6) Considerations
(a) Skill needed to locate pressure points
(b) Distal wounds difficult to control with pressure points
(c) Proper application
   i) Considerable force needed
   ii) Loss of distal pulses

e. Tourniquet application
(1) General description
(a) Last resort
(b) Tourniquet placed between heart and wound
(c) Tourniquet placed within 2” of wound

(2) Physiology of intervention
(a) Restriction of blood flow to and from extremity
(b) Prevent additional significant blood loss
(c) Promote localized clotting

(3) Indications
(a) Control of profuse hemorrhage
(b) Last resort after failure of other methods
   i) Direct pressure
   ii) Elevation
   iii) Pressure dressings
   iv) Pressure points

(4) Contraindications - bleeding controllable by other methods

(5) Assessment of intervention
(a) Positive control of hemorrhage
(b) Prevention of additional significant blood loss

(6) Considerations
(a) Last resort technique
(b) Used only on wounds to extremities
(c) Never apply directly to knee or elbow
(d) Once in place never loosen
   i) Emboli
   ii) Restart bleed
   iii) Tourniquet shock
(e) Never use wire/ string/ rope

IV. Review of bandaging and dressing material used in conjunction with soft tissue trauma
A. Dressings
   1. Sterile
      a. Has gone through process to eliminate bacteria from dressing material
      b. Used when infection is a concern
   2. Non-sterile
      a. Has not gone through process of sterilization
      b. Used when infection is not a concern
   3. Occlusive
a. Does not allow passage of air through dressing
b. Useful for wounds involving thorax and major vessels
   (1) Negative pressure may cause air to enter thorax or vessel
   (2) Occlusive dressing may prevent pneumothorax and air embolism
   (3) Be aware of the possibility of developing tension pneumothorax

4. Non-occlusive
   a. Allows air to pass through dressing
   b. Useful for most standard open soft tissue injuries

5. Adherent
   a. Dressing may adhere to wound surface by incorporating wound exudate into dressing mesh
   b. May assist in controlling acute bleeding

6. Non-adherent
   a. Allows passage of wound exudate so that dressing will not adhere to wound surface
   b. Will not damage surface of wound when removed
   c. Used after wound closure

B. Complications of improperly applied dressings
   1. Hemodynamic
      a. Hemorrhage
      b. Exsanguination
      c. Ischemia
   2. Structural - immediate and distal
      a. Vessels
      b. Nerves
      c. Tendons
      d. Muscles
      e. Integument/tissue
      f. Organ
   3. Patient discomfort

C. Basic concepts of open wound dressing
   1. Assessment
      a. Cleansing
      b. Irrigation
      c. Debridement
      d. Definitive care as appropriate
   2. Non-adherent based dressing
      a. Function/description
      b. Indications
      c. Contraindications
      d. Considerations
      e. Technique
         (1) Location
         (2) Application/implementation
   3. Absorbent gauze sponges
      a. Function/description
      b. Indications
      c. Contraindications
      d. Considerations
      e. Technique
4. Gauze wrappings
   a. Function/ description
   b. Indications
   c. Contraindications
   d. Considerations
   e. Technique
      (1) Location
      (2) Application/ implementation

5. Taping
   a. Function/ description
   b. Indications
   c. Contraindications
   d. Considerations
   e. Technique
      (1) Location
      (2) Application/ implementation

V. Management of specific soft tissue injuries not requiring closure
A. Dressing and bandaging specific soft tissue injuries
   1. General principles
      a. Dressing application
      b. Antibacterial ointment
      c. Immobilization
      d. Bandaging
   2. Injury location
      a. Scalp dressings
      b. Facial dressings
      c. Ear or mastoid dressings
      d. Neck dressings
      e. Shoulder dressings
      f. Truncal dressings
      g. Groin, hip, and upper dressings
      h. Hand and finger dressings
      i. Elbow and knee dressings
      j. Ankle, knee, and foot dressings
   3. Open wounds that should be dressed, bandaged and then transported for further evaluation
      a. Wound with neural compromise
      b. Wound with vascular compromise
      c. Wound with muscular compromise
      d. Wound with tendon/ ligament compromise
      e. Wound with heavy contamination
      f. Wound with cosmetic complications
      g. Wound with foreign body complication
   4. Any other soft tissue trauma can be dressed and bandaged
      a. Consider transport versus patient discharge on-scene

B. Evaluation
   1. Overview
a. Treat and release
b. Treat and refer
c. Treat and transport

2. Tetanus vaccine
a. Overview
b. Tetanus vaccine preparation
c. Immunization recommendations
d. Allergic/ hypersensitive reactions

3. Patient instructions
a. Verbal
   (1) Overview of written
   (2) Patient counseling
b. Written
   (1) Protection and care of wound area
   (2) Dressing change and follow-up
   (3) Wound cleansing recommendations
   (4) Signs of wound infection

C. Potential and seriousness of wound infection
1. Description
   a. Common complication
   b. Serious complication
   c. Goal
      (1) Prevent from infection
      (2) Protect from infection

2. Mechanism
   a. Interruption in stratum corneum
   b. Non sterile external environment
   c. Integumentary microflora

3. Risk factors
   a. Wound characteristics
   b. Wound mechanism
   c. Technical elements
   d. General patient condition

4. Complication of wound infection
   a. General patient recovery
   b. Localized
   c. Systemic
   d. Ancillary conditions

D. Wound infection causal factors
1. Time
   a. Cleansing
   b. Repair

2. Mechanism

3. Location

4. Severity
   a. Complications
   b. Tissue damage

5. Contamination

6. Preparation

7. Cleansing
8. Technique of repair
9. General patient condition

VI. Special considerations regarding soft tissue injuries
A. Treatment priorities for patients with soft tissue injuries in conjunction with other life-threatening injuries
   1. Assess for and treat any existing critical injuries to
      a. Airway
         (1) Obstructed airway
         (2) Concurrent immobilization of spine
      b. Breathing
         (1) Inadequate breathing
      c. Circulation
         (1) Hypoperfusion
         (2) Hemorrhage
   2. Life-threatening injuries are managed prior to isolated soft tissue trauma
   3. Institute appropriate emergency medical care for life-threat
      a. Life-threatening airway trauma
      b. Life-threatening head trauma
      c. Life-threatening thoracic trauma
      d. Life-threatening abdominal trauma

B. Emergency medical care of patients with penetrating impalations, chest, and abdominal injuries
   1. Penetrating chest injury
   2. Open wound to the abdomen
   3. Impaled object
      a. Assessment
         (1) Location
         (2) Complications
      b. Treatment
         (1) Stabilization

C. Treatment priorities for patients with amputations and avulsion
   1. Avulsion
      a. Assessment
      b. Emergency care of avulsion
         (1) Airway, ventilation, and circulation
         (2) Stabilize affected area
         (3) Dress and bandage wound appropriately
         (4) Package avulsed area, if complete avulsion, for transport
         (5) Immediate and safe transport to appropriate facility
   2. Amputations
      a. Assessment
      b. Emergency care of amputations
         (1) Airway, ventilation, and circulation
         (2) Stabilize injured area
         (3) Do not complete partial amputations
         (4) Dress and bandage wound appropriately
         (5) Package amputated body part for transport
         (6) Immediate and safe transport to appropriate facility
   3. Crush injuries
      a. Treatment should be started before the patient arrives in the ED
b. Goals
   (1) Prevent sudden death
   (2) Prevent renal failure
   (3) Salvage limbs
   (4) Institute as early as possible (in the field before the patient is extricated)
   (5) ABCs as always

c. Fluid therapy for hypovolemia
   (1) Consider bolus of 1-1.5 liters
   (2) Up to 12 liters may be needed in the first 24 hours

d. Alkalization of the urine
   (1) Consider adding sodium bicarbonate to IV fluid at one amp per liter to start
   (2) The goal is to maintain urine pH > 6.5
   (3) Controls hyperkalemia and acidosis to prevent acute myoglobinuria renal failure (changes the structure of myoglobin so it passes through the renal tubules)
   (4) If done in the emergency department, irrelevant to out-of-hospital

e. Maintain urine output
   (1) Goal of diuresis of at least 300 cc per hour
   (2) Consider Mannitol (10 g or 20% solution to each liter of IV fluid)
   (3) Loop diuretics such as Lasix are not recommended as they may acidify the urine
   (4) The “ideal fluid” for crush injury is D5 1/2 normal saline with one amp sodium bicarbonate and 10 g or 20% solution of mannitol
   (5) Treats hypovolemia
   (6) Corrects acidosis
   (7) Treats hyperkalemia, thus preventing sudden cardiac dysrhythmias
   (8) Prevents renal failure

f. Further treatment of hyperkalemia
   (1) Forced alkaline diuresis may be adequate
   (2) CaCl is not indicated unless there is a danger of hyperkalemia dysrhythmia
   (3) Consider insulin/ glucose for severe hyperkalemia (25cc D50W followed by 10 units regular insulin IV)

g. Other considerations for management - physician may come to the scene prior to extrication
   (1) Amiloride
      (a) K+ sparing diuretic
      (b) Inhibits Na-Ca exchange - protection against “Ca++paradox”
      (c) Administer before reperfusion - before crushed limb is extricated
         i) Free radical scavengers
      (d) Superoxide dismutase (superoxide-anion scavenger)
   (2) Catalase (H₂O₂ ----> H₂O and O₂)
   (3) Mannitol - scavenges hydroxyl free radicals
   (4) Allopurinol (xanthine oxidase inhibitor)
      (a) May prevent reperfusion induced injury in ischemic skeletal muscle and organs such as the kidneys
      (b) Would have to administer before extrication or as soon as possible afterwards
   (5) Hospital use of hemodialysis
(a) Role in patient who ultimately develops renal failure
(b) Can prevent permanent renal damage in patient who is not septic
(c) Prevention is the key - delays in IV fluid therapy leads to acute renal failure

4. Local injury treatment is controversial
5. Closed crush injury
   a. Use of a tourniquet prior to release of crushed limb may be beneficial
   b. Compartment syndrome
      (1) If intracompartmental pressure > 40mm Hg or > diastolic pressure - 30 mm Hg, fasciotomy is recommended by many if accompanied by clinical signs and symptoms
      (2) Concern of increasing tissue necrosis requiring disfiguring debridement and increased risk of sepsis in those injuries older than 8 hours old
      (3) Early fasciotomy can preserve limb, avoid Volkmann’s contracture and preserve cutaneous sensation
      (4) Medical direction may consider a field fasciotomy
6. Open crush injuries
   a. Wound care required - thorough cleansing, debridement, prophylactic antibiotics, administration of tetanus prophylaxis
   b. ED surgical consultation
7. Amputation
   a. Field - increased risk of infection/ sepsis, but may be necessary for extrication
   b. In-hospital - for severely injured limb
8. Hyperbaric oxygen treatment
   a. Shown to decrease tissue necrosis
   b. Can inhibit lipid peroxidation form oxygen free radicals (via increased levels of superoxide dismutase)
   c. Decreases muscle edema
   d. Most useful if done early
D. Documentation/ record keeping for patients with soft tissue trauma
   1. Document patency of airway, ventilation, and circulation and any interventions administered
   2. Document patient assessment thoroughly
   3. Document general description of wound as to size, location, depth, associated complications
      a. Neurovascular status
      b. Joint injury
      c. Infection
   4. Document past medical history, medications, and allergies to medications
   5. Document all treatment/ interventions rendered
   6. Document patient’s response(s) to treatment rendered
   7. Document patient's understanding of procedure