# Chapter 27, Soft-Tissue Injuries

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## 1. Introduction to Soft-Tissue Injuries

Soft tissue injuries are common [4]. They can be as serious as life-threatening internal injuries [4]. You should not become distracted by dramatic open wounds [5]. Soft tissues can be injured by blunt force, penetrating injury, barotrauma, or burns [5]. Wound care is frequently performed in emergency departments [8]. Most injuries require basic interventions [9]. Death is often related to hemorrhage or infection [10]. Infection can be life or limb threatening [11]. This is especially true in children, older adults, and people with weakened immune systems [11]. Simple protective actions can often prevent injuries and complications [12].

## 2. Anatomy and Physiology of the Skin

| Layer | Description | Contents | Function | Source |
|---|---|---|---|---|
| Epidermis | Tough external layer, watertight covering [21] | Composed of several layers [22] | Forms a watertight covering for the body [21] | [21] |

| | | | | |
|---|---|---|---|---|
| Dermis | Inner layer of skin [22] | Hair follicles, sweat glands, subcutaneous glands [23] | Provides skin with nutrients and oxygen via blood vessels [24] | [22] |
| Mucous Membranes | Line body openings [26] | N/A | Provide a protective barrier against bacterial invasion [26] | [26] |

The skin is the body's first line of defense [14]. It protects against external forces and infection [14]. It is the largest organ in the body [15]. Skin varies in thickness with age and location [18]. Injuries can expose blood vessels, nerves, and bones [16]. The EMT must control bleeding and prevent contamination [17]. Protecting wounds and applying dressings is important [17]. The skin is a barrier against infection [27]. It is also a sensory organ [27]. It assists with body temperature regulation [27]. Skin helps maintain fluid balance [27]. A break in the skin allows bacteria to enter [28]. This increases the possibility of infection, fluid loss, and loss of temperature control [28].

## 3. Pathophysiology of Wound Healing

Healing of wounds is a natural process [31]. It involves several overlapping stages [31]. All stages aim to maintain homeostasis [31]. Cessation of bleeding is the primary concern [32]. The next stage is inflammation [32]. Additional cells move to the damaged area to begin repair [32]. White blood cells migrate to combat pathogens [33]. Lymphocytes destroy bacteria and pathogens [34]. Mast cells release histamine [34]. Inflammation removes foreign material and damaged cells [35]. A new layer of cells moves into the region [36]. New blood vessels form to bring oxygen and nutrients [37]. Collagen provides stability to damaged tissue [38]. It joins wound borders, closing the open tissue [38].

## 4. Closed Soft-Tissue Injuries

| **Type of Injury** | **Cause** | **Characteristics** | **Potential Complications** | **Source** |
|---|---|---|---|---|
| Contusion | Blunt force trauma [39] | Epidermis intact, damaged dermis cells, torn blood vessels [40] | Blue/black discoloration (echomosis) [42] | [39] |

| | | | | |
|---|---|---|---|---|
| Hematoma | Damage to a large blood vessel [44] | Collection of blood in damaged tissues or body cavity [43] | Rapid bleeding, extensive tissue damage [44] | [43] |
| Crush Injuries | Compression of soft tissue [46] | Damage depends on force and duration [46] | Circulation cut off, tissue destruction [47] | [46] |
| Crush Syndrome | Area trapped for longer than 4 hours, compromised arterial flow [48] | Muscle cells die, release harmful substances into circulation [49] | Cardiac arrest, renal failure [50] | [48] |
| Compartment Syndrome | Edema and swelling cause increased pressure [51] | Pressure interferes with circulation, nutrient/oxygen delivery impaired [52] | Pain (especially on passive movement), tissue death [53] | [51] |

contusions result from blunt force trauma [39]. The epidermis remains intact [40]. Cells within the dermis are damaged [40]. Small blood vessels are usually torn [41]. Blood buildup produces ecchymosis [42]. A hematoma is blood collection within damaged tissues [43]. It occurs when a large blood vessel is damaged [44]. Crush injuries depend on force and duration [46]. Continued compression cuts off circulation [47]. crush syndrome can develop after prolonged entrapment [48]. Damaged muscle cells release harmful substances [49]. compartment syndrome develops from increased pressure within a compartment [51]. This interferes with circulation and oxygen delivery [52]. Severe closed injuries can damage internal organs [56]. Reassess skin color, temperature, and pulses distal to the injury [55].

## 5. Open Soft-Tissue Injuries

| **Type of Injury** | **Cause** | **Characteristics** | **Management/Considerations** | **Source** |
|---|---|---|---|---|
| Abrasion | Friction when body part rubs or scrapes a rough surface [60] | Wound of the superficial skin layer [60] | Caused by friction [60] | [60] |

| | | | | |
|---|---|---|---|---|
| Laceration | Jagged cut by sharp object or blunt force [61] | Tissue is torn [61] | Caused by sharp object or blunt force [61] | [61] |
| Avulsion | Separates layers of tissue [61] | Tissues become completely detached or hang as a flap [61] | Often significant bleeding, replace flap if possible, never remove [62] | [61] |
| Amputation | Body part is completely severed [64] | Body part completely severed [64] | Complete severance of a body part [64] | [64] |
| Penetrating Wounds | Usually from sharp objects or projectiles [65] | Small entrance wounds, little external bleeding, foreign material may be present deep inside [65] | May damage deep structures, risk of infection, assess carefully [65] | [65] |
| Impaled Object | Object remains embedded in tissue [65] | May damage structures deep inside, foreign material present [65] | Remove only if in cheek/mouth obstructing airway or in chest interfering with CPR [125] | [65] |
| Blast Injuries | Explosion [70] | Often result in multiple penetrating injuries [70] | Mechanism due to blast wave, flying debris, or victim being thrown [71] | [70] |

Four types of open wounds are abrasions, lacerations, avulsions, and penetrating wounds [58]. An abrasion is a superficial wound from friction [60]. A laceration is a jagged cut from a sharp object or blunt force [61]. An avulsion separates tissue layers [61]. Tissues may be detached or hang as a flap [61]. avulsions often have significant bleeding [62]. Replace the flap if possible; never remove it [63]. An amputation is complete severance of a body part [64]. penetrating wounds usually have small entrance wounds [65]. They produce little external bleeding [65]. Impaled objects may damage deep structures [65]. Foreign materials inside tissue can cause infection [66]. Stabbings and shootings often cause multiple penetrating injuries [67]. Assess

patients carefully to find all wounds [68]. Count penetrating injuries, especially gunshot wounds [68]. Blast injuries often result in multiple penetrating injuries [70]. blast injury mechanisms include the blast wave, flying debris, and the victim being thrown [71].

## 6. Patient Assessment for Soft-Tissue Injuries

Assessing a closed injury is more difficult than an open injury [75]. Begin with scene size-up [75]. Look for indicators of the mechanism of injury [76]. This helps suspect underlying injuries [76]. The mechanism of injury provides safety threat information [77]. Use all information to evaluate scene safety [78]. Consider if additional resources are needed [78]. Perform a primary assessment [79]. Focus on identifying life threats and transport priority [79]. Form your general impression [80]. Look for indicators of the patient's condition seriousness [81]. Assess responsiveness using AVPU [81]. Administer high flow oxygen to patients less than alert [81]. Treat for potential shock and provide immediate transport [81]. Significant bleeding is an immediate life threat [82]. It must be controlled before opening the airway [82]. If life-threatening external bleeding is obvious, control it first [82]. This helps treat for shock [83]. Ensure the airway is clear and patent [85]. Auscultate for clear breath sounds [85]. Assess for equal chest rise [85]. Provide high flow oxygen or assist ventilations if needed [85]. Evaluate open chest wounds for air movement [86]. Consider appropriate transport destination [88]. Patients needing immediate transport include those with a poor general impression or altered level of consciousness [89]. Dyspnea, abnormal vital signs, shock, and severe pain also indicate immediate transport [89].

Next, take history [90]. Investigate the chief complaint [90]. Use SAMPLE and OPQRST for trauma patients [90]. Look for DCAP-BTLS during assessments [90]. If the patient is unresponsive, get history from another source [91]. Chronic medical conditions can complicate open injuries [92]. Assess interventions and repeat vital signs en route [93]. Assess all autonomic regions [94]. Look for jugular vein distension and tracheal deviation in the neck [95]. Check the pelvis for stability [96]. Check the abdomen for tenderness, rigidity, and bruising [97] . Check extremities and record pulse, motor, and sensory function [98]. Signs of poor perfusion indicate rapid transport [99]. These include tachycardia, tachypnea, low blood pressure, and cool, pale skin [100]. Conduct reassessment regularly during transport [101]. Repeat the primary assessment [101]. Pay attention to areas of concern [101]. Assess the effectiveness of prior treatments [101]. Reassess vital signs and chief complaint [101]. Identify and treat changes in condition [102]. Communicate and document findings for the hospital [102]. Include mechanism of injury and patient position [102]. Report estimated blood loss [102]. Include location and description of wounds treated [102]. Describe the size and depth of the injury [102]. Provide an accurate account of treatment [102].

## 7. Emergency Care for Closed Soft-Tissue Injuries

Small contusions generally require no special emergency care [103]. Note their presence to determine injury extent [104]. More extensive closed injuries can have significant swelling and bleeding [105]. This could lead to hypovolemic shock [105]. Injuries might not show swelling or bruising initially [106]. Watch any injury closely while caring for the patient [107]. Treat closed soft tissue injuries using the rice mnemonic [108]. rice stands for Rest, Ice, Compression, Elevation, and Splinting [108]. Be alert for signs of developing shock [108]. Signs include anxiety, changes in mental status, increased heart rate and respiratory rate [108]. Diaphoresis, cool skin, and decreased blood pressure are also signs [108]. If the patient shows signs of shock, treat accordingly and aggressively [109].

## 8. Emergency Care for Open Soft-Tissue Injuries

| Injury Type | Emergency Care Procedures | Source |
|---|---|---|
| General Open Wounds | Follow standard precautions, control bleeding with direct pressure, pressure dressings, splints, or tourniquets; apply sterile dressing, do not remove material, flush small wounds with sterile water if no significant bleeding [110] | [110] |
| Abdominal Wounds | Cover with sterile moistened gauze, secure with occlusive dressing, keep organs moist and warm, immediate transport to trauma center [120] | [120] |
| Impaled Objects | Treat following skill drill 27-1, remove only if obstructing airway in cheek/mouth or interfering with CPR in chest, secure and shorten long objects, provide rapid transport [124] | [124] |
| Open Neck Injuries | Cover with occlusive dressing, apply manual pressure, do not compress both carotid arteries simultaneously, use caution depending on mechanism [130] | [130] |
| Animal Bites (Small) | Consider contaminated and potentially infected, evaluated by physician, major concern for rabies, ensure animal is secured before entering scene [134] | [134] |
| Human Bites | Contains wide range of bacteria/viruses, considered very serious if skin penetrated, lacerations by human tooth can cause serious infection spread [138] | [138] |

| | | |
|---|---|---|
| Bites (General Care) | Apply dry sterile dressing, immobilize area with splint/bandage, transport for surgical cleansing and antibiotics [142] | [142] |

Before caring for an open wound, follow standard precautions [110]. If life-threatening bleeding is seen, apply direct pressure [110]. Control bleeding using direct pressure and elevation [111]. Pressure dressings or splints, and possibly tourniquets can be used [111]. All open wounds are assumed contaminated and a risk of infection [112]. Applying a sterile dressing reduces contamination risk [113]. Do not remove material from the open wound [114]. Small wounds without significant bleeding can be flushed with sterile water [114]. Chemical burns should be flushed to remove chemicals [115]. Hospital personnel usually clean open wounds [116]. Splinting can help control bleeding even without a fracture [117].

For abdominal wounds, organs may expose from the wound [118]. This is an evisceration [119]. Cover the wound with sterile, moistened gauze [120]. Secure the gauze with an occlusive dressing [121]. Keep the organs moist and warm [122]. Most abdominal wounds require immediate transport to a trauma center [123]. Treat impaled objects following skill drill 27-1 [124]. Remove impaled objects only if obstructing the airway in the cheek/mouth or interfering with CPR in the chest [125]. Secure and shorten very long objects [126]. Provide rapid transport [126]. Open neck injuries can be life-threatening [127]. Open neck veins may suck air in [128]. Air entering a blood vessel can block blood flow in the lungs [129]. This can cause cardiac arrest from an air embolism [129]. Cover the wound with an occlusive dressing [130]. Manually apply pressure [130]. Do not compress both carotid arteries simultaneously [130]. This could impair brain circulation and cause a stroke [130]. Use caution with neck injury patients depending on the mechanism [131].

Small animal bites are heavily contaminated with bacteria [134]. Consider all small animal bites contaminated [134]. All small animal bites should be evaluated by a physician [134]. Rabies is a major concern [135]. Rabies is a fatal viral infection of the central nervous system [135]. It affects all warm-blooded animals [135]. Children may be seriously injured or killed by dogs [136]. The animal may attack you [137]. Do not enter the scene until the animal is secured [137]. Human mouths contain a wide range of bacteria and viruses [138]. Consider animal bites that penetrate the skin very serious [139]. lacerations by a human tooth can cause serious infection spread [140]. For bites, apply a dry sterile dressing [142]. Immobilize the area with a splint or bandage [142]. Transport to the emergency department for wound cleansing and antibiotics [142].

## 9. Burns: Types and Pathophysiology

Burns are among the most serious and painful injuries [143]. A burn occurs when the body receives too much radiant heat [143]. This results in injury [143]. Sources include heat, toxic chemicals, or electricity [144]. Always perform a complete assessment [145]. Determine if other

serious injuries are present [145]. Children, older patients, and those with chronic illness are more likely to experience shock from burns [146]. Burns are soft tissue injuries over a large area [147]. They are created by transfer of energy [147]. Energy can be radiation, thermal, or electrical [147]. Thermal burns occur when skin is exposed to temperatures over 111°F [148]. Burn severity correlates with temperature, concentration of heat energy, and duration of exposure [149]. Burn injuries are progressive [150]. Greater heat energy means a deeper wound [150]. Exposure time is important [151]. Thermal injury can occur in unresponsive or paralyzed patients [151]. The skin barrier is destroyed when a person is burned [153]. Burns create a high risk for infection [153]. Hypothermia, hypovolemia, and shock are also risks [153]. Burns to the airway are significant [154]. Loose mucosa in the hypopharynx swells [154]. This leads to complete airway obstruction [154]. Circumferential chest burns can compromise breathing [155]. Circumferential extremity burns can lead to compartment syndrome [156]. This results in neurovascular compromise and irreversible damage [156]. Call for advanced life support if you suspect complications [156].

## 10. Burn Severity and Assessment

| Factor Determining Severity | Description | Source |
|---|---|---|
| Depth | How deep the burn is (superficial, partial thickness, full thickness) | [157] |
| Extent | Percentage of total body surface area burned (rule of palm, rule of nines) | [157] |
| Critical Areas Involved | Face, upper airway, hands, feet, genitalia, over joints [157] | [157] |
| Patient Factors | Pre-existing medical conditions/injuries, age (under 5, older than 55) [157] | [157] |

Five factors determine burn severity [157]. These are depth and extent of the burn [157]. Critical areas involved are also important [157]. These include the face, upper airway, hands, feet, or genitalia [157]. Pre-existing medical conditions or injuries matter [157]. Patient age is a factor (under five or older than 55) [157]. Burns to the face are important due to potential airway involvement [158]. Hand, foot, or joint burns are serious due to potential function loss from scarring [158].

There are three types of burn depth: first, second, and third degree [158]. First degree is superficial [160]. It involves only the epidermis [161]. The burn site is often painful [162]. A

sunburn is a first degree burn example [163]. Partial thickness is a second degree burn [164]. It involves the epidermis and some dermis [165]. These burns do not destroy the skin's entire thickness [166]. Subcutaneous tissue is not injured [166]. Skin is typically moist and mottled [167]. White or red blisters are present [167]. Second degree burns can cause intense pain [167]. Full thickness or third degree burns extend through all skin layers [168]. They may involve subcutaneous layers, muscle, bone, or internal organs [168]. The burned area is dry and leathery [169]. It may appear white, dark brown, or charred [169]. If nerve endings are destroyed, the burned area may have no feeling [170]. Surrounding, less severe areas may be very painful [171]. Significant airway burns are serious [171]. Signs may include singed hair, soot, hoarseness, or hypoxia [171]. These patients need rapid transport for advanced airway management [171].

The extent of burns is important [172]. We calculate extent using the rule of palm or rule of nines [173]. The rule of palm estimates surface area using the patient's palm size [174]. A patient's palm is roughly one percent of their total body surface [174]. The rule of nines divides body parts into sections [175]. Each section represents approximately nine percent of the total body surface area [175]. Proportions differ in infants, children, and adults [176]. When calculating extent, include only partial and full thickness burns [176]. Document superficial burns but do not include them in the estimation [176].

## 11. Assessment and Emergency Care for Burns

When assessing a burn, classify it [179]. Classify based on source, depth, and severity [179]. Ensure the scene is safe [180]. Make sure factors causing the burn are not a hazard [180]. Determine the type of burn sustained [181]. The patient's report provides important information [181]. Assess the scene for environmental hazards [182]. Determine the number of patients [182]. Call for additional resources [182]. Consider potential for spinal immobilization or injuries [182].

Begin the primary assessment with a rapid assessment [183]. Form a general impression [183]. Look for clues to determine severity [183]. Be suspicious of clues indicating abuse [183]. Consider the need for manual stabilization [183]. Check responsiveness using AVPU [184]. Administer high flow O2 to patients less than alert [184]. Provide immediate transport [184]. For airway and breathing, look for singed facial hair or soot [185]. Heavy secretions or coughing may indicate respiratory burn [186]. For circulation, control major bleeding [187]. If obvious life-threatening external bleeding exists, control it first [187]. Treat the patient for shock [187]. Treat shock in burn patients by preventing heat loss [188]. Cover them with a blanket [188]. Consider rapid transport for airway issues or significant burns [189]. Signs of external bleeding also require rapid transport [189]. Consider rendezvousing with advanced life support [189].

Next, take history [190]. Investigate the chief complaint [190]. Be alert for signs of other injuries [191]. If burned in a confined space, suspect inhalation injuries [191]. Obtain medical history [191]. Be alert for injury-specific signs and symptoms [191]. Obtain a SAMPLE history [191]. Ask about difficulty breathing or swallowing [191]. Check for an emergency medical identification device

[191]. The secondary assessment is a physical exam [192]. Assess the patient head to toe using DCAP-BTLS [193]. Estimate burn extent using the rule of nines [194]. Determine burn classification and severity [194]. Package the patient for transport based on findings [195]. Obtain vital signs [195]. Use monitoring devices like oxygen saturation and carbon monoxide monitors [195]. Reassess the patient and interventions en route [196]. Communicate and document findings for the hospital [196]. Describe how the burn occurred [196]. Describe the extent, body surface area, depth, and location [196]. Specifically mention and document if special areas are involved [197].

Your first responsibility is to stop the burning process [199]. Prevent additional injury [199]. When caring for a burn patient, follow skill drill 27-2 steps [200]. Stop the burning source [206]. Cool the burned area [206]. Remove all jewelry [206]. Maintain a high suspicion for inhalation injuries [207]. Increased exposure time increases damage [207]. Larger burns make the patient susceptible to hypothermia or hypovolemia [207]. Apply a dry sterile dressing to patients with large surface burns [208].

## 12. Specific Types of Burns and Their Management

| Type of Burn | Cause | Characteristics | Management | Source |
|---|---|---|---|---|
| Thermal Burns | Heat (scolds, open flames, hot objects, steam, flash) [201] | Depth varies by cause (flame often deep, scalds common in children/handicapped, contact rarely deep unless trapped) [202] | Stop burning source, cool burned area, remove jewelry, high suspicion for inhalation injuries, apply dry sterile dressing to large burns [206] | [200] |
| Inhalation Burns | Burning in enclosed spaces without ventilation [209] | Upper airway damage from superheated gases, lower airway damage from chemicals/particulate matter [210] | Immediate intervention for severe upper airway swelling, consider ALS, apply cool mist aerosol/humidified oxygen, suspect CO/cyanide poisoning [211] | [209] |

| | | | | |
|---|---|---|---|---|
| Chemical Burns | Toxic substance contact (strong acids/alkalis) [220] | Severity related to type, concentration, duration, eyes vulnerable [223] | Ensure scene safety (wait for Hazmat), wear chemical-resistant gloves/eye protection, remove dry chemicals by brushing, flush liquid chemicals with large amounts of water (15-20 min), flush burned eyes, properly dispose of decon fluid [223] | [220] |
| Electrical Burns | Contact with high or low voltage electricity [229] | Injury appears where electricity enters and exits the body, large deep tissue injury, cardiac/respiratory arrest risk [234] | Ensure scene safety, begin CPR/AED if indicated, provide supplemental oxygen, monitor closely, apply dry sterile dressings, splint suspected fractures, prompt transport [233] | [229] |
| Taser Injuries | Taser darts puncture skin [240] | Barbs are impaled objects [241] | Treated as impaled objects, removed by physician (sometimes EMT per protocol), potential complications with underlying disorders (excited delirium), have AED access [241] | [240] |

| | | | | |
|---|---|---|---|---|
| Radiation Burns | Exposure to radioactive isotopes/radiation (terrorist attacks) [245] | Potential threat from alpha (little penetration), beta (greater penetration), gamma (very penetrating) radiation [246] | Determine exposure and if ongoing, wait for Hazmat for decon, remove clothes for most contaminants, treat ABCs once no threat, notify ED, identify source/duration of exposure, limit duration, increase distance, use shielding [252] | [245] |

Thermal burns are caused by heat [201]. Common causes are scolds or open flames [201]. Flame burns are often deep [202]. Scalds are commonly seen in children and handicapped adults [202]. Contact with hot objects causes contact burns [203]. Contact burns are rarely deep unless the patient is trapped [203]. Steam burns can produce topical or scald burns [204]. Flash burns are produced by an explosion [205]. Lightning strikes can cause a flash burn [205].

Inhalation burns occur when burning is in enclosed spaces [209]. Upper airway damage is from superheated gases [210]. Lower airway damage is from chemicals or particulate matter [210]. Severe upper airway swelling may occur [211]. This requires immediate intervention [211]. Consider requesting advanced life support [212]. Signs of edema include stridor or singed nasal hairs [212]. Burns to the face may also be present [212]. Cool mist aerosol or humidified oxygen can reduce minor edema [213]. Consider carbon monoxide intoxication [215]. Hydrogen cyanide is also a concern [217]. Signs involve the central nervous system, respiratory, and cardiovascular systems [218]. Pre-hospital treatment includes decon and supportive care [219].

Chemical burns occur when a toxic substance contacts the body [220]. Most are caused by strong acids or alkalis [221]. The eyes are particularly vulnerable [222]. Severity relates to the chemical type, concentration, and duration [223]. Ensure you can safely approach the patient [223]. You may need to wait for the Hazmat team to decon [224]. Wear appropriate chemical-resistant gloves and eye protection [224]. Remove the chemical from the patient first [225]. If dry, brush it off before flushing [225]. Remove all clothing and jewelry [225]. Take care not to contact the chemical [226]. The patient should be properly deconned [227]. For liquid chemicals, immediately flush the area with large amounts of water [227]. Continue flushing for 15 to 20 minutes after burning stops [228]. If eyes are burned, hold the eye open and flood with a gentle water stream [229]. Properly dispose of decon fluid [229].

Electrical burns result from contact with electricity [229]. High voltage burns can occur from power lines [229]. Ordinary household current can cause severe burns and dysrhythmias [229].

Electricity needs a complete circuit to flow [230]. An insulator prevents a circuit from completing [231]. A conductor allows current to flow [231]. The human body is a good conductor [232]. Electrical burns happen when the body completes a circuit [232]. Type of current, magnitude, and voltage affect seriousness [232]. Your safety is important at electrical scenes [233]. A burn appears where electricity enters and exits [234]. Dangers include deep tissue injury and cardiac/respiratory arrest [235]. Management includes starting CPR if indicated [238]. Use an AED and be prepared to defibrillate [238]. Give supplemental oxygen and monitor closely [238]. Apply dry sterile dressings to burn wounds [239]. Splint suspected fractures [239]. Provide prompt transport [239].

Taser injuries involve darts puncturing the skin [240]. Barbs are generally treated as impaled objects [241]. They are removed by a physician [241]. EMTs may remove barbs in some jurisdictions per protocol [241]. Potential complications exist with underlying disorders [242]. Excited delirium is commonly associated with illegal drug ingestion [243]. Excited delirium is a true emergency and warrants advanced life support [243]. Taser use with excited delirium has been associated with dysrhythmias and cardiac arrest [245]. Have access to an AED when responding to taser patients [245].

Radiation burns are a potential threat [245]. Incidents relate to radioactive isotopes or terrorist attacks [245]. Determine if radiation exposure occurred and if it's ongoing [245]. There are three types of radiation: alpha, beta, and gamma [246]. Alpha has little penetrating injury [246]. Beta has greater penetrating power [247]. Gamma is very penetrating [249]. It passes through the body and solid materials [249]. Most accidents involve gamma rays or X-rays [250]. People exposed to radiation generally don't risk others [251]. In explosions, patients may be contaminated [252]. Maintain a safe distance and wait for Hazmat for decon [252]. Most contaminants are removed by removing clothes [253]. Once no threat exists, treat ABCs [253]. Notify the emergency department [254]. Identify the source and duration of exposure [254]. Limit your exposure duration [255]. Increase distance from the source [255]. Attempt to place shielding between you and the source [255].

## 13. Dressings and Bandages

Dressings and bandages have three functions [256]. They control bleeding [256]. They prevent further wound damage [256]. They prevent further contamination and infection [256]. Sterile dressings are used for most wounds [257]. These include conventional sizes and small adhesive dressings [257]. Non-adherent roller dressings are also used [257]. The universal dressing is ideal for large open wounds [258]. Gauze pads are appropriate for smaller ones [258] . Adhesive dressings are useful for minor wounds [259]. Occlusive dressings prevent air and liquids from entering or exiting [259]. They are made from Vaseline gauze, aluminum foil, or plastic [260]. They cover sucking chest wounds or abdominal eviscerations [260]. They are also used for penetrating back wounds and neck injuries [260].

To keep dressings in place, use roller gauze, triangular bandages, tape, or self-adherence [261]. Self-adhering soft roller bandages are easiest to use [262]. Adhesive tape holds small dressings in place [263]. It helps secure larger dressings [263]. Some people are allergic to adhesive tape [264]. Use paper or plastic tape for these individuals [264]. Do not use elastic bandages to secure dressings [265]. If the injury swells, the bandage may become a tourniquet [265]. This can cause further damage [265]. Always check a limb distal to the bandage [266]. Check for signs of impaired circulation and loss of sensation [266]. Air splints and vacuum splints stabilize broken extremities [267]. They can be used with dressings to control bleeding [267]. If a wound continues to bleed despite direct pressure, quickly use a tourniquet [268].

## 14. Conclusion and Review

If a young man is struck in the forearm by a baseball [271]. He complains of pain and has slight swelling and ecchymosis [272]. There is no external bleeding [272]. This describes a contusion [273]. It is a contusion from blunt force trauma [274]. A severe compression injury cutting off blood flow below the injury is compartment syndrome [275].

A 45-year-old clerk was shot in the right chest [276]. Blood is bubbling from the wound with every breath [277]. The most immediate action is to put an occlusive dressing [278]. This prevents air from entering the wound [278]. This is a sucking chest wound [278]. Applying ice to a hematoma will cause vasoconstriction [279]. This decreases bleeding [279].

The primary reason for applying a sterile dressing to an open injury is to control external bleeding [281]. While reducing infection risk is important, controlling bleeding is primary [280].

The most appropriate way to manage an open abdominal wound with protruding organs is using a moist sterile dressing [282]. Secure it with an occlusive dressing [282]. Do not apply pressure [283].

A 22-year-old male is attacked with a knife in his chest [284]. He is not breathing and pulseless [284]. If a knife is present and interfering with CPR, carefully remove it [285]. Control the bleeding and begin CPR [285].

Severe burns include full thickness burns involving hands, feet, or genitalia [287]. Burns of more than 10% body surface area are also severe [287]. 5% or more can also be considered severe [288].

A five-year-old boy pulled a barbecue grill on himself [289]. He has partial and full thickness burns to his anterior chest and both arms circumferentially [290]. Using the pediatric rule of nines, the anterior chest is 9% [292]. Each arm is 9% [292]. This totals 27% [292].

Regarding chemical burns, it is false to remove a dry chemical after flushing with water [293]. You should brush off the dry chemical first, then flush [294].