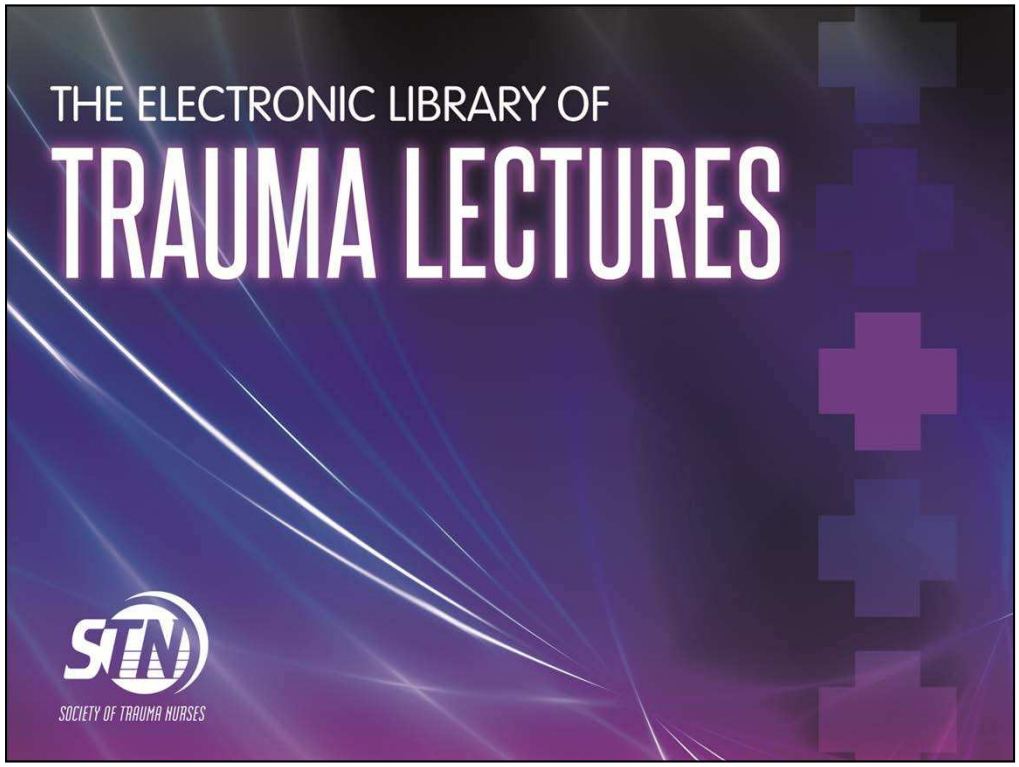
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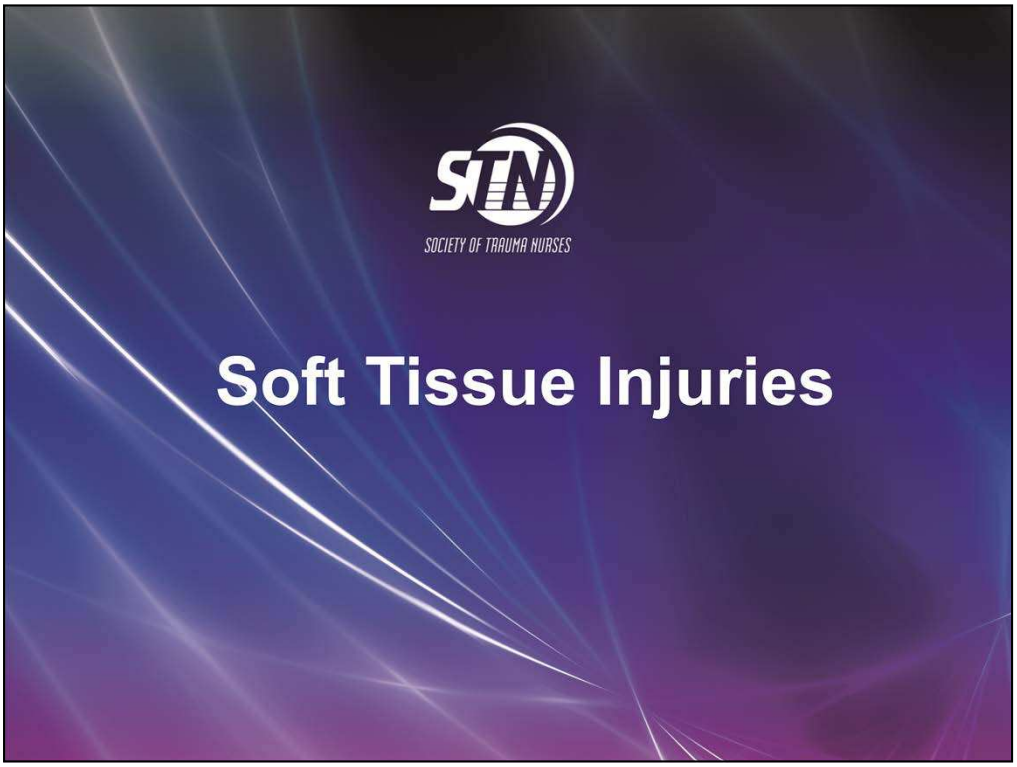
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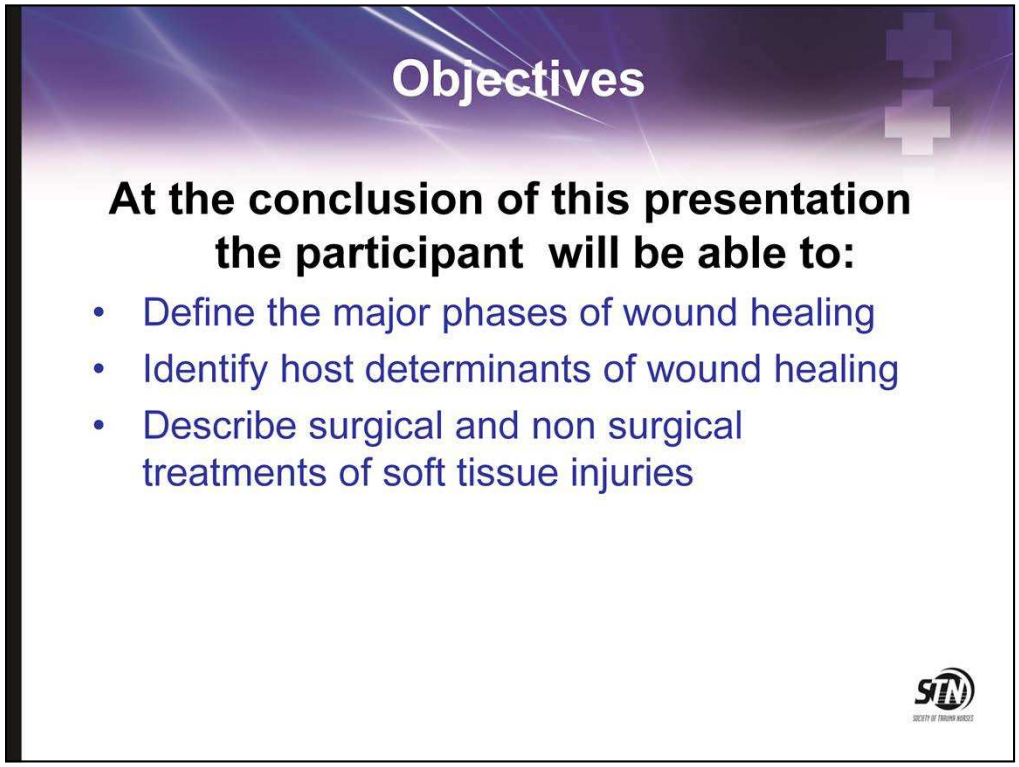
Soft Tissue Injuries



Wound care requires an understanding of skin anatomy, physiology of wound healing and treatments as well as the impact of infection and other complications on wound healing.

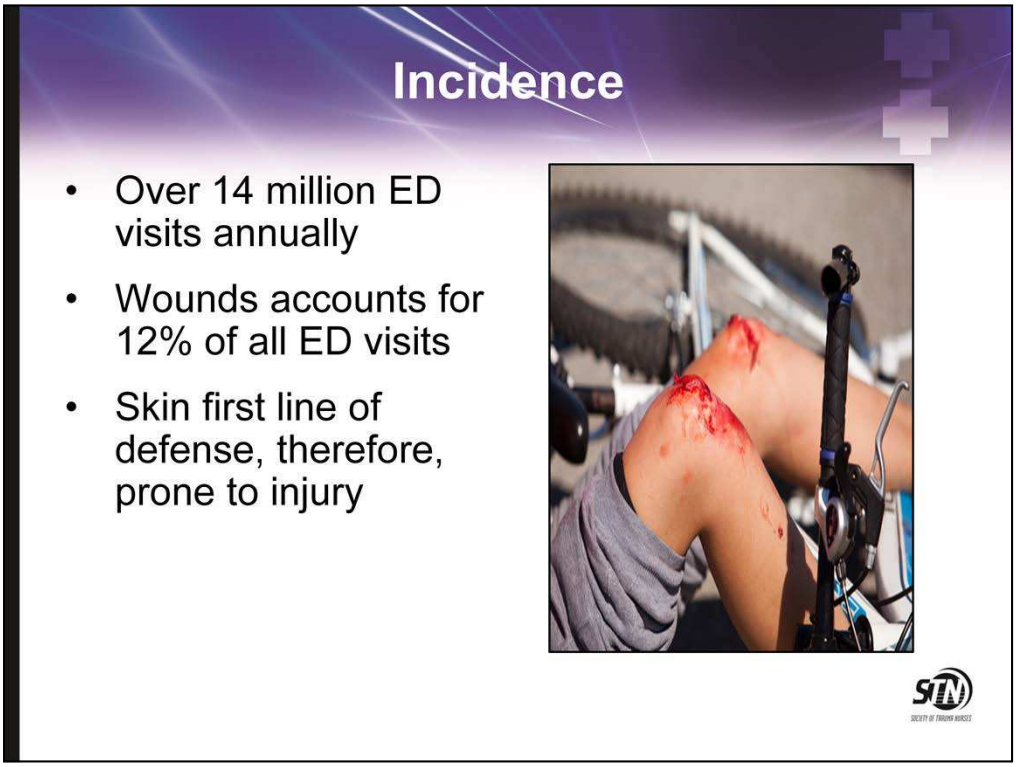
The Objectives of this presentation are:

•Define normal healing process

•Describe risks for abnormal wound healing

•Describe treatments for soft tissue injuries

•List complications of soft tissue wounds



14 million open wounds, superficial injuries and contusions per CDC's **National Hospital Ambulatory Medical Care Survey: 2004 Emergency Department Summary**

Skin is the first line of defense in any injury and thus is nearly always injured when trauma occurs.

Although soft tissue injuries may not be the primary critical illness, it can contribute to the overall challenge of clinical management.

•As with all injuries, it is important to clearly understand the mechanism so as to provide the clues to the magnitude of the injury.

•Traumatic wounds result from the impact of an energy source applied against the skin and underlying structures.

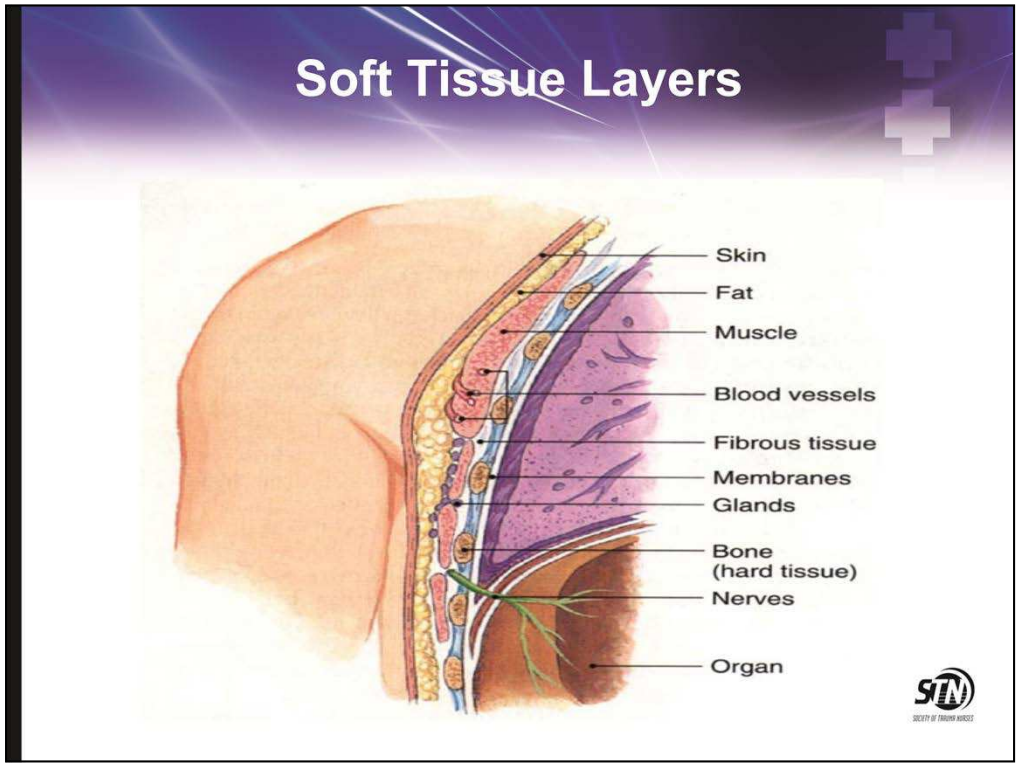
•Soft tissue injury is common in both blunt and penetrating trauma

•The environment the injury occurred is perhaps more important to tissue injury than with any other injury of the body.

•If the injury occurred in the setting of an occupational exposure, there may be particular chemicals, acids, or bases that need to be considered. These types of injuries can result in devitalized tissue that my need debridement as well as ongoing assessment as this wound continues to evolve over time. (Chemical injuries are covered in the Burn Chapter)

•High pressure injection injuries are unique due to the depth of the injury which requires surgical assessment and treatment.

•Compression injuries are unique due to the resulting systemic effects of necrosis on the body, which may result in life threatening complications of renal failure and sepsis.



Traumatic injury may result in damage to any or all layers of the integument.

Skin

- Largest organ of the body
- Functional barrier to insults

Subcutaneous tissues

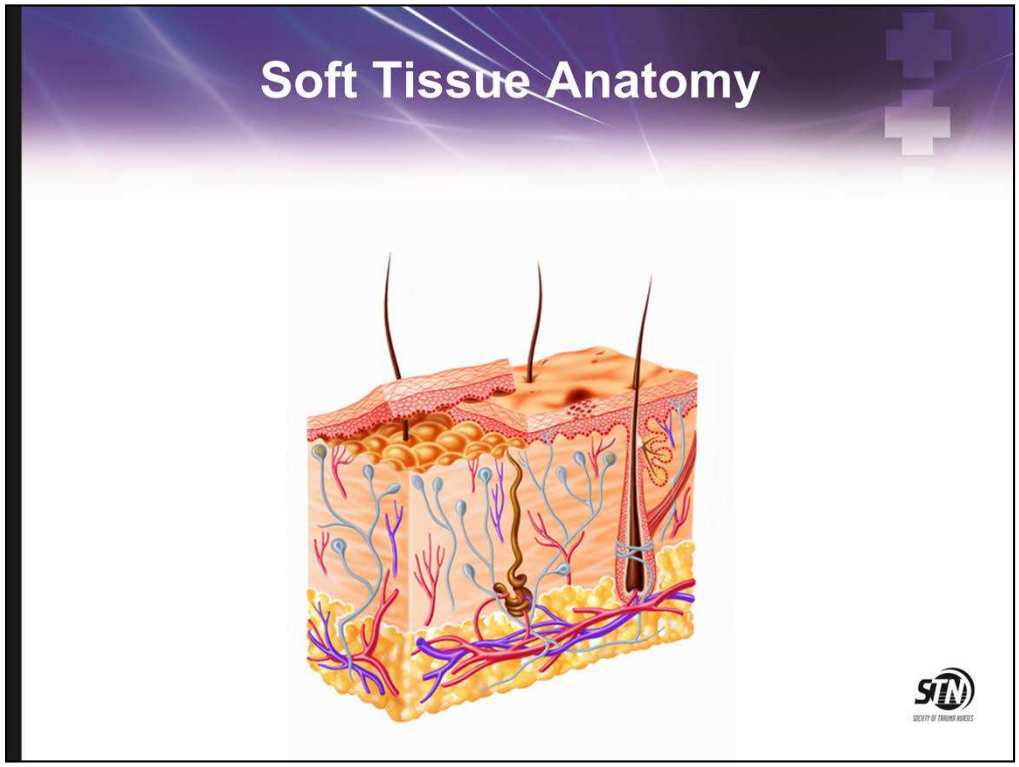
- Has few vascular connections which leave subcutaneous tissue vulnerable to decreased perfusion which has implications for wound healing

Muscles

- Muscles has a high metabolic demand and is relatively intolerant of ischemia
- Vascularity is high to serve the high metabolic demand

Nerves

- Retrieve sensory information and signal nerves to execute action



Cross section illustration of skin

Skin has two distinct layers:

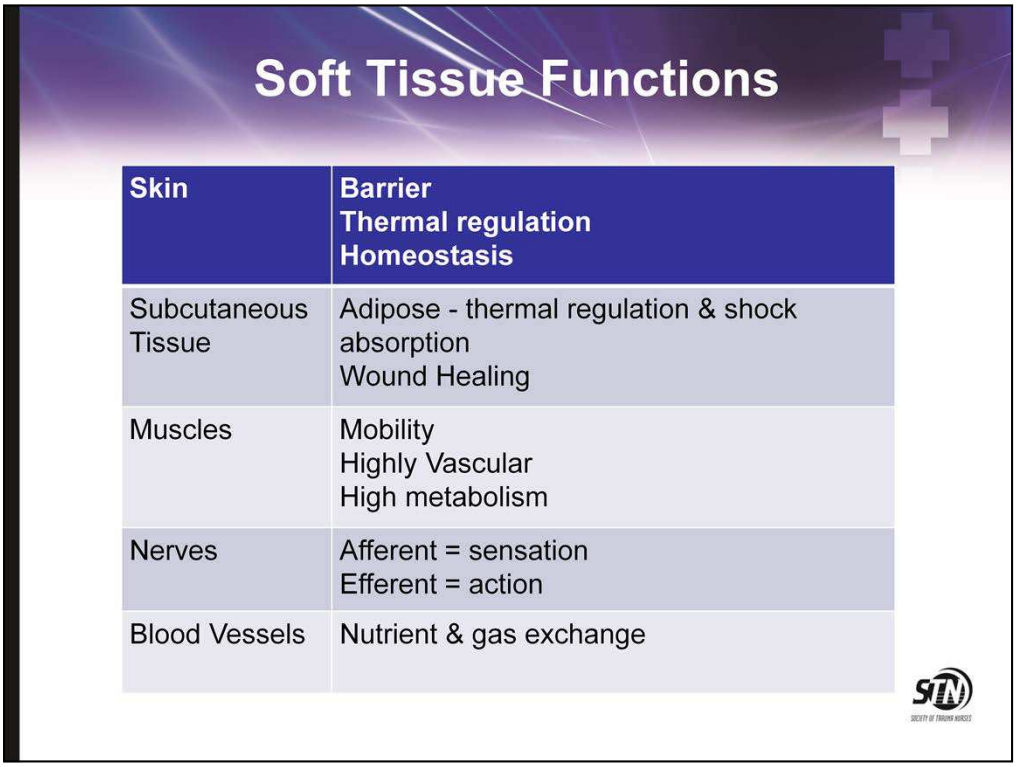
1. Epidermis
2. Dermis

•A superficial abrasion involves the epidermal layer of the skin.

•Partial thickness injuries, the most common wound, involve the epidermal layer and a portion of the dermal layer.

•The epidermis consists of 5 layers and its primary functions include:

- •protective barrier
- •organization of cell content
- •synthesis of vitamin D
- •Pigmentation
- •pain / touch receptors
- •differentiates into hair, nails, sweat & sebaceous glands



Subcutaneous tissue: found below the dermis, supports blood supply to the dermis. Primarily composed of adipose tissue which provides a cushion between skin layers, muscles, and bones, providing insulation.

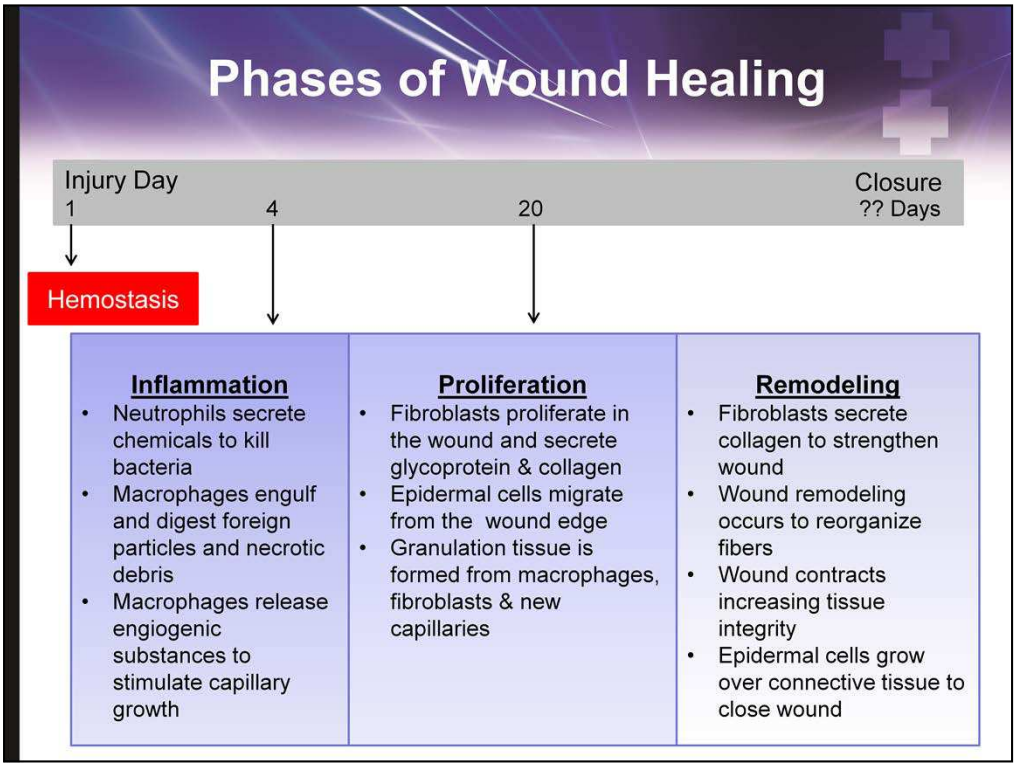
Muscles: lie directly under the skin everywhere except at the bony protuberances. Supports mobility.

Nerves:

Efferent – Carry nerve impulses away from the CNS to execute actions to voluntary muscles or for involuntary functions such as sweating or vessel dilatation.

Afferent – Carry sensory information (temperature, pain, pressure, position, and vibration) from receptors or sense organs in the joints and skin toward the central nervous system.

Extent of nerve damage is often unclear at the initial examination and must be evaluated serially.



•The 3 major phases of healing overlap to some degree.

Hemostasis:

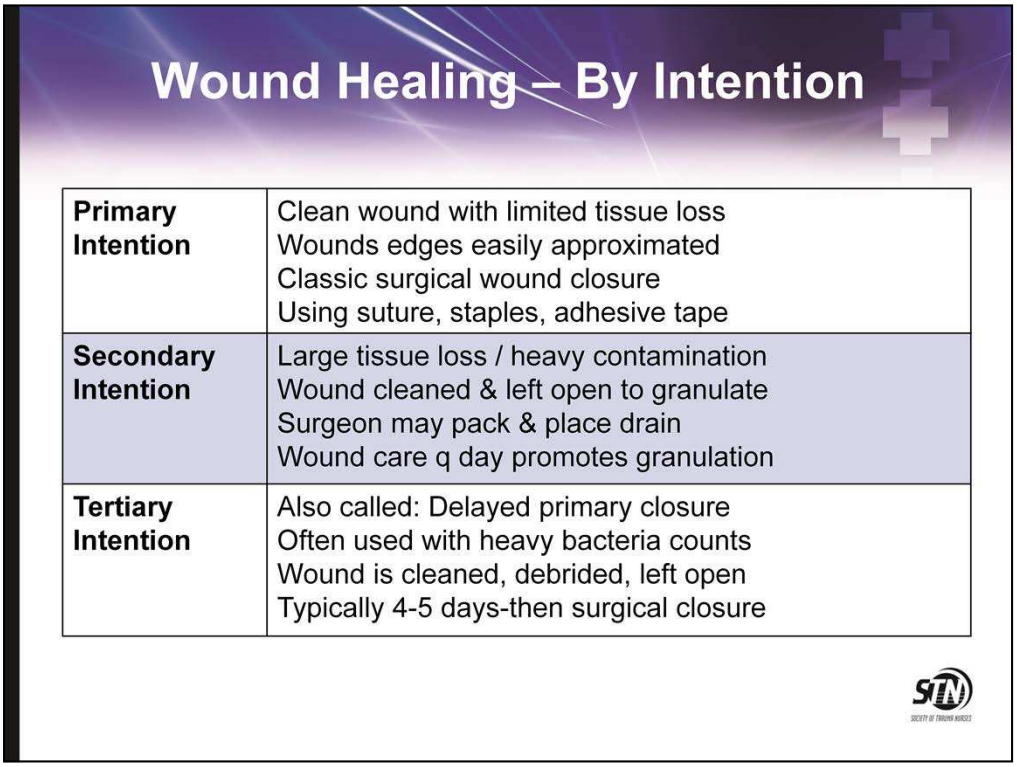
•when a wound extends through the epidermis, blood vessels are disrupted and a clot forms. This begins the process of normal tissue repair followed by the inflammatory process and tissue regeneration.

•Critical periods are during the first few days and weeks post injury because multiple cellular events are occurring.

Time to Closure

•The actual time for the healing process depends on several patient and environmental factors.

•Generally, wounds recover approximately 50% of tensile strength after 40 days and almost 100% by 150 days after injury



Primary intention

Involves epidermis and dermis without total penetration of dermis healing by process of epithelialization

When wound edges are brought together so that they are adjacent to each other (re-approximated)

Minimizes scarring

Most surgical wounds heal by primary intention healing

Wound closure is performed with sutures (stitches), staples, or adhesive tape

Examples: well-repaired laceration, well reduced bone fractures, healing after flap surgery

Secondary intention

The wound is allowed to granulate

Surgeon may pack the wound with a gauze or use a drainage system

Granulation results in a broader scar

Healing process can be slow due to presence of drainage from infection

Wound care must be performed daily to encourage wound debris removal to allow for granulation tissue formation

Examples: tooth extraction, sockets, poorly reduced fractures.

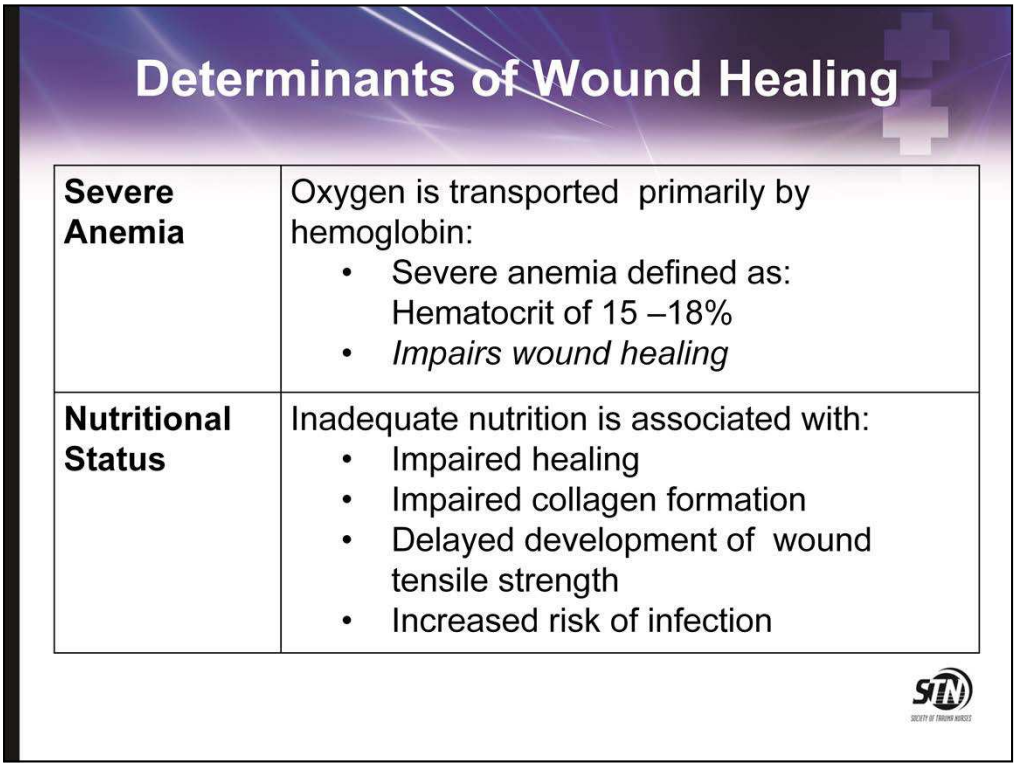
Tertiary intention

(Delayed primary closure or secondary suture):

The wound is initially cleaned, debrided and observed, typically 4 or 5 days before closure.

The wound is purposely left open

Examples: healing of wounds by use of tissue grafts



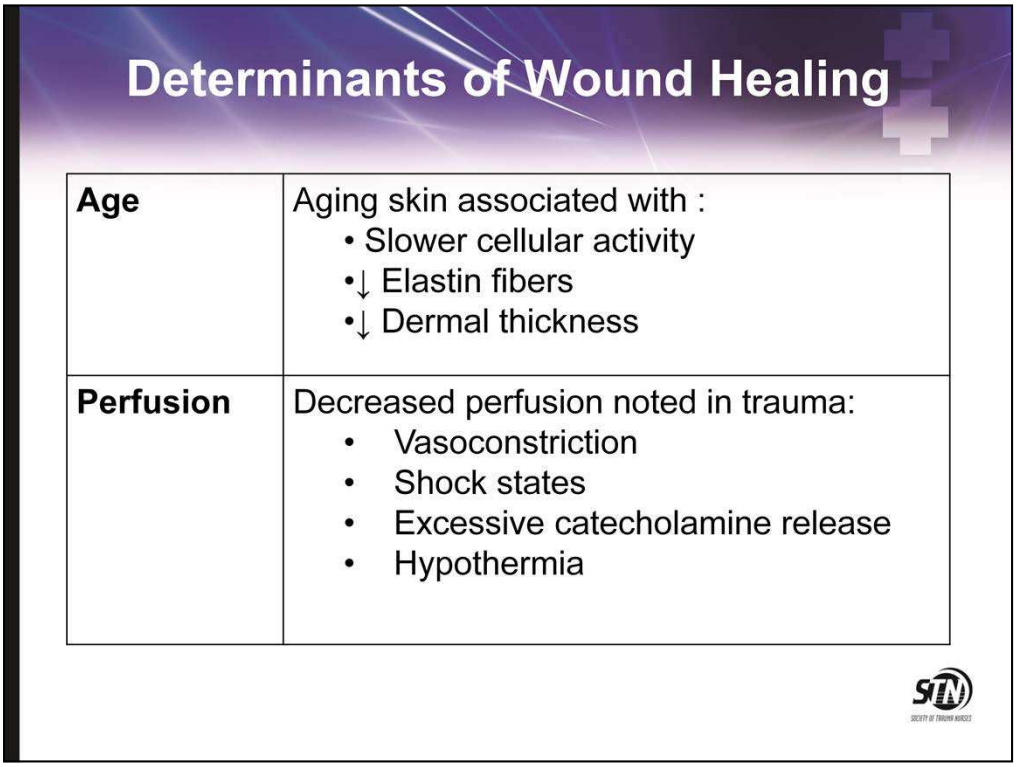
Anemia

•Mild anemia does not affect wound healing however severe anemia with hematocrit levels down as low as 15-18% have been associated with impaired wound healing.

Anemia impairs wound healing significantly!

Nutritional Status

•Inadequate amounts of protein, fat, carbohydrates, calories, vitamins, and minerals contribute to impaired wound healing.

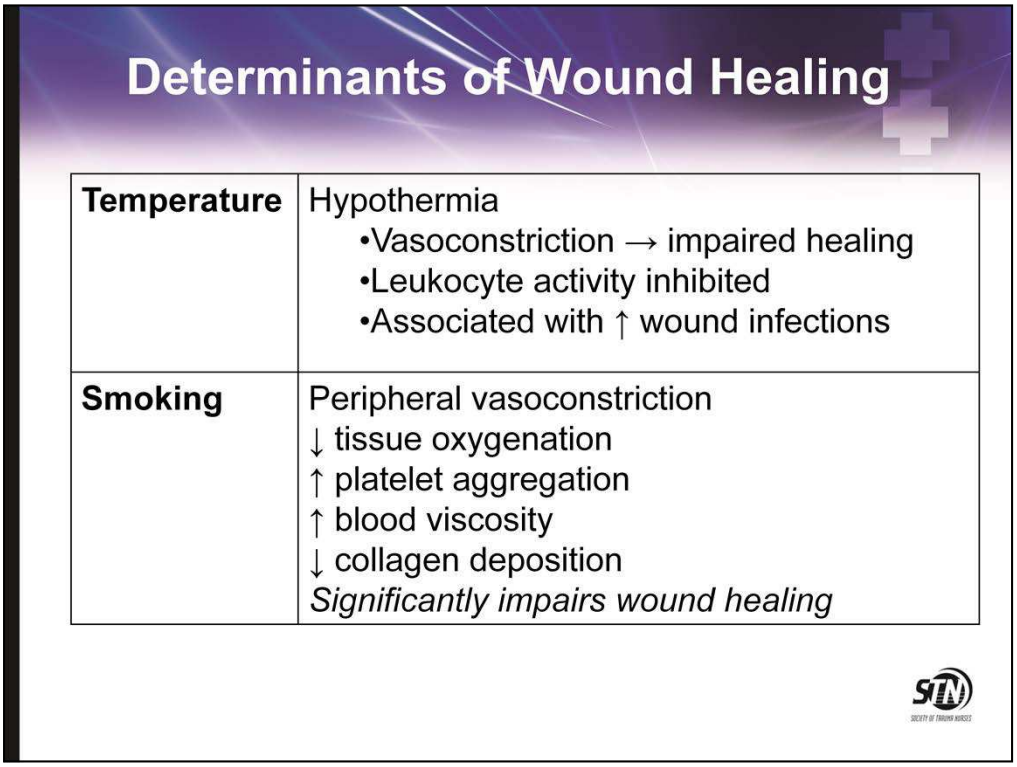


Age

•The elderly have decreased skin thickness and elasticity

Perfusion

•Perfusion is affected by any vasoconstriction state



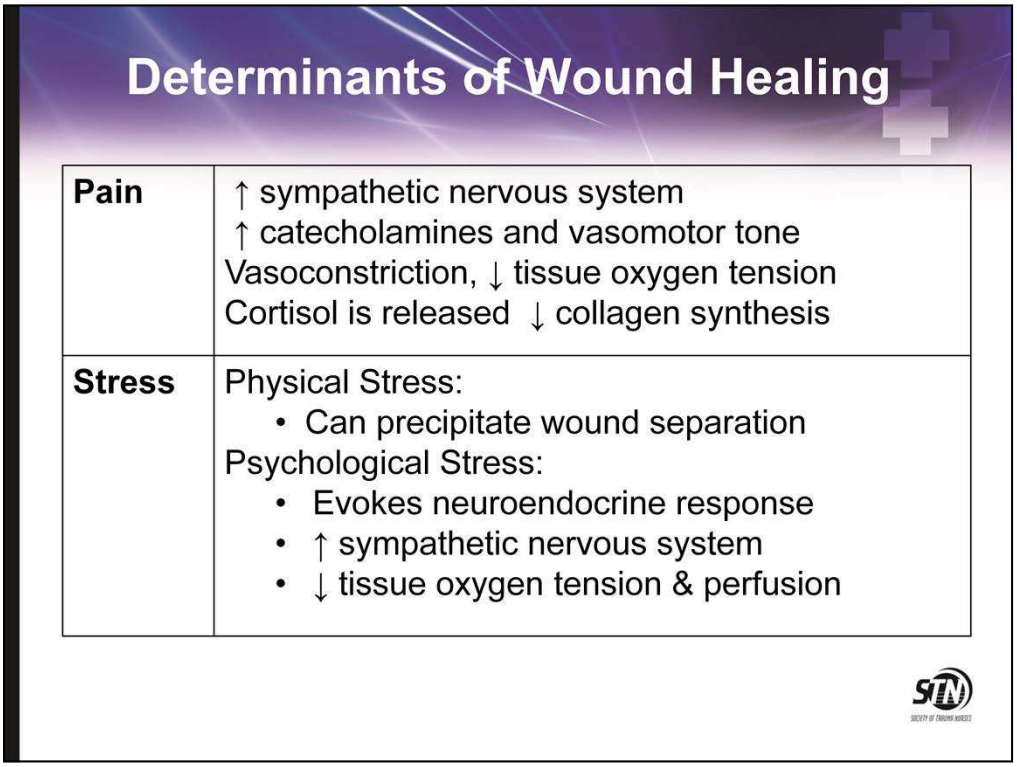
Temperature

•Hypothermia is associated with impaired healing through vascular impairment and impaired leukocyte activity

Smoking

•Multiple effects of smoking include decreased tissue oxygenation and collagen deposition as well as a increased blood viscosity.

•Smoking impairs wound healing significantly!



Pain

•Stimulation of the Sympathetic Nervous System (SNS) causes catecholamines to be released which in turn increases vasomotor tone

•Vasoconstriction results further depressing wound tissue oxygen tension and healing

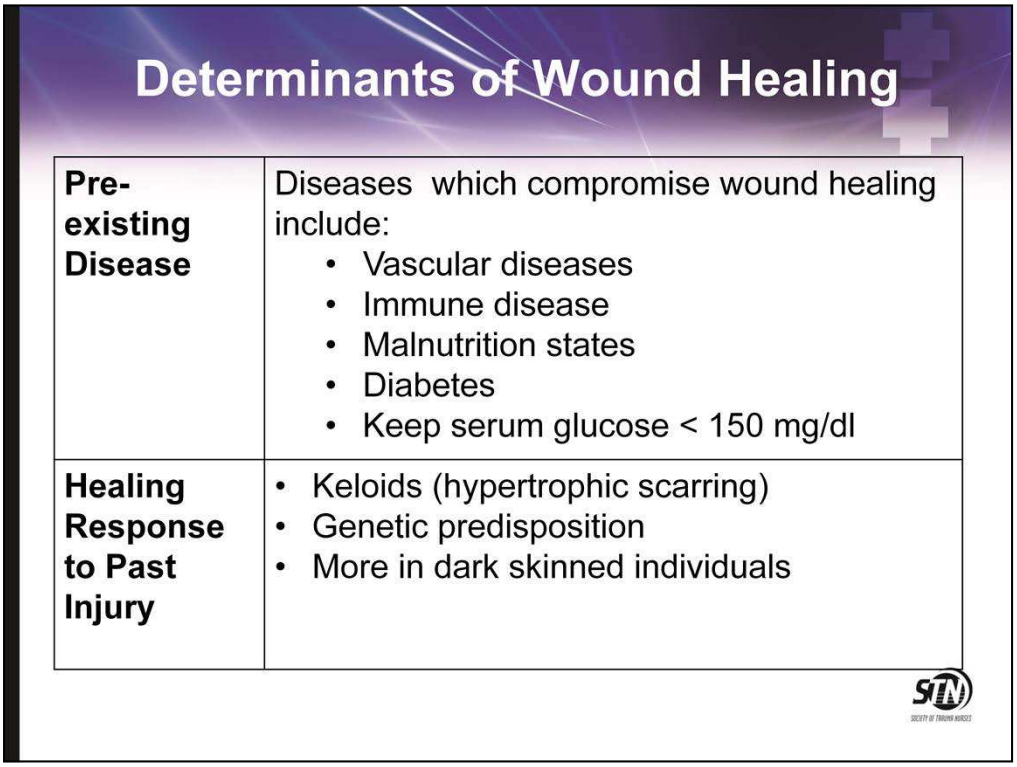
Stress

•Physical and psychological stressors both can impair healing by either movement and separation of wound edges or increased SNS stimulation

•Multiple trauma initiates a state of significant physiologic stress

•The stress response is complex and involves inflammatory, endocrine, and central nervous system functions

•The collective result is a catabolic state frequently leading to depleted protein stores.



•Primary vascular disease compromises perfusion

•Immuocompetence required for healing

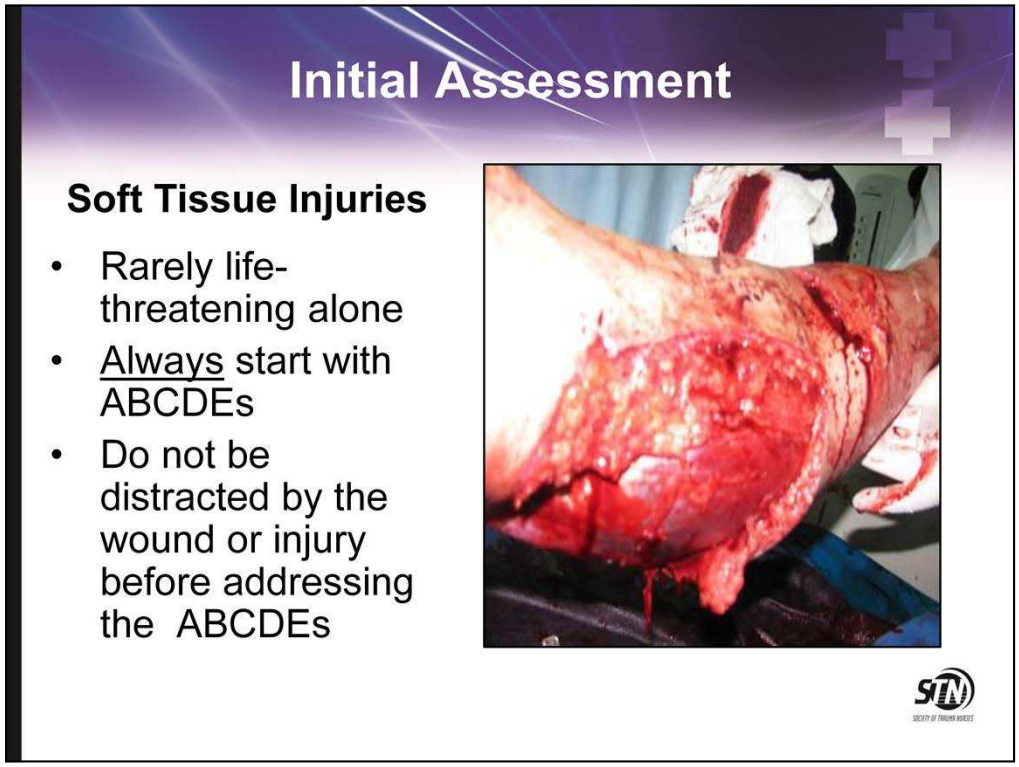
•Nutrition is essential for the anabolism required for tissue repair

•Diabetes is associated with small vessel disease, which limits blood supply to the wound area.

Keloids

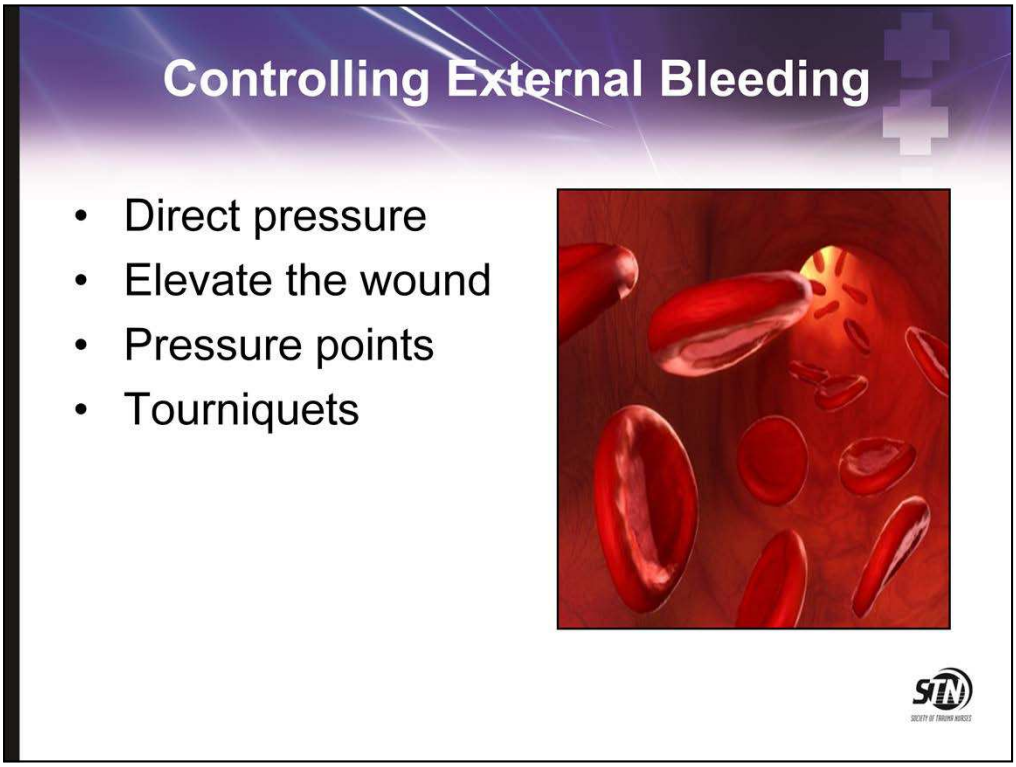
•Some patients prone to keloid formation (Hypertrophic scarring)

•Genetically more common among Asians and African Americans



Avoid being distracted!

Soft tissue injuries can appear quite gruesome and have the potential to side track the resuscitation team from performing the primary assessment clinical management.

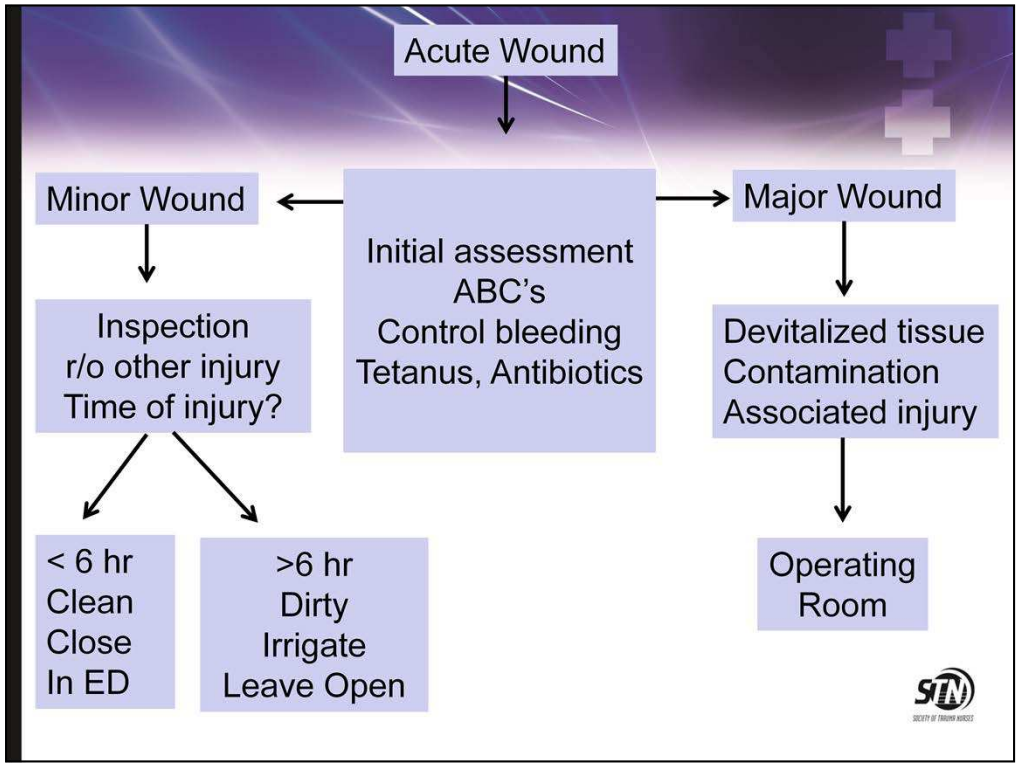


Direct Pressure is the initial treatment. Holding direct pin point pressure over a wound will help stop the bleeding and promote clotting. Dressings without direct pressure should be avoided as they can mask further bleeding causing delayed recognition of continued uncontrolled hemorrhage.

Elevate the wound if possible, which will slow the flow of blood again making it easier to control bleeding with direct pressure.

Pressure points are areas of the body where blood vessels run closer to the surface. By pressing on these vessels, blood flow further away will be slowed, thereby allowing direct pressure to stop the bleeding. Examples include the brachial artery, the femoral artery, and the popliteal artery.

Tourniquets historically had fallen out of favor due to the fear of potential damage to the extremity. However, recent experience from the Iraq war has proven them to be effective in saving both limb and life.



The clinical judgment of treatment of wounds is based on many things.

Assess time from injury: In general wounds that have been left open for more than 6-8 hours should be left open, other wise primary closure is best.

An exception is wounds to the face and scalp which do well even when closed after 8 hours due to good blood flow.

Heavy contamination and extensive tissue destruction are best managed open.

This schematic offers an example of the clinical judgment required to manage soft tissue wounds.

•Proper wound management begins with a detailed history of the mechanism of injury as well as the patient's past medical history.

•Furthermore, the time elapsed from injury is essential in the assessment of possible wound infection, as well as to determine whether or not primary wound repair would be advantageous.

•Allergies to antibiotics, latex, and local anesthetics should also be documented and considered in wound evaluation and treatment.

Tetanus

•Tetanus is a systemic infection caused by *Clostridium tetani.* Spores are present in soil, contaminated water, and anywhere animal and human excrement are found.

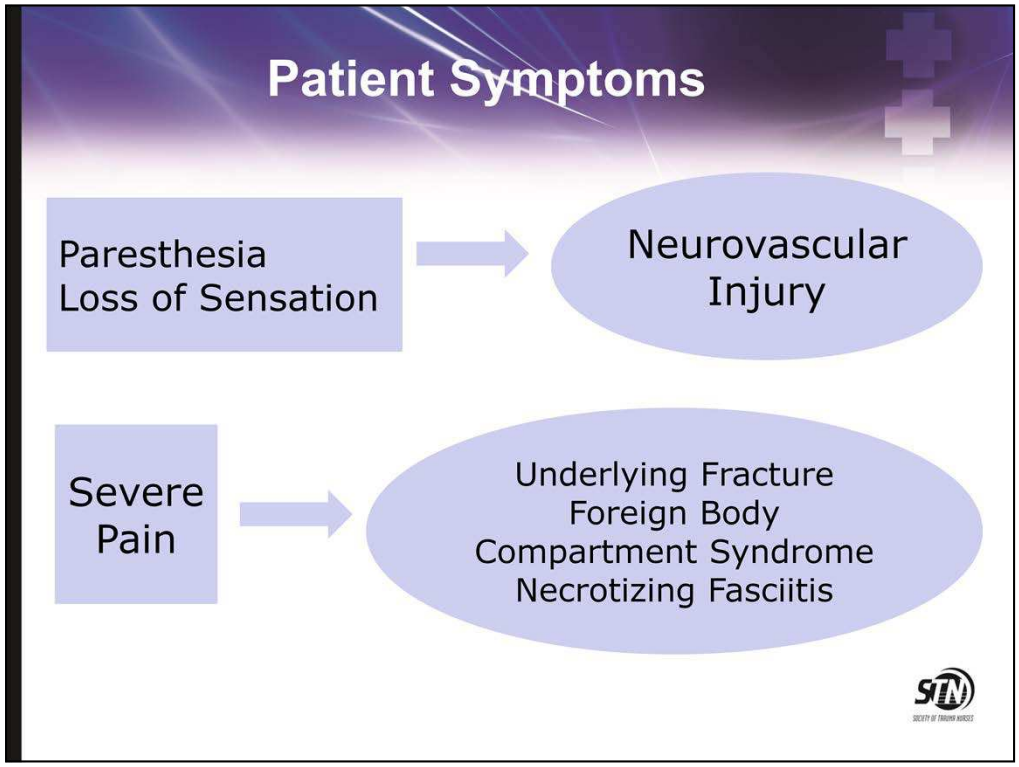
•Tetanus infection can occur from any break in the skin integrity. Prevention of tetanus includes thorough wound cleansing and immunization.

•Tetanus immune globulin (TIG) in addition to TD diphtheria toxoid is recommended for the unimmunized person.

• Diphtheria toxoid (Td) is should be administered to adults it if has been >10 years since last booster or >5 years in a tetanus prone wound (contaminated, crush, puncture wounds)

•Hand dominance and occupation should be identified as they may influence surgical treatment decisions later.

•Obtaining a detailed history will help guide further management, workup, and final patient disposition.



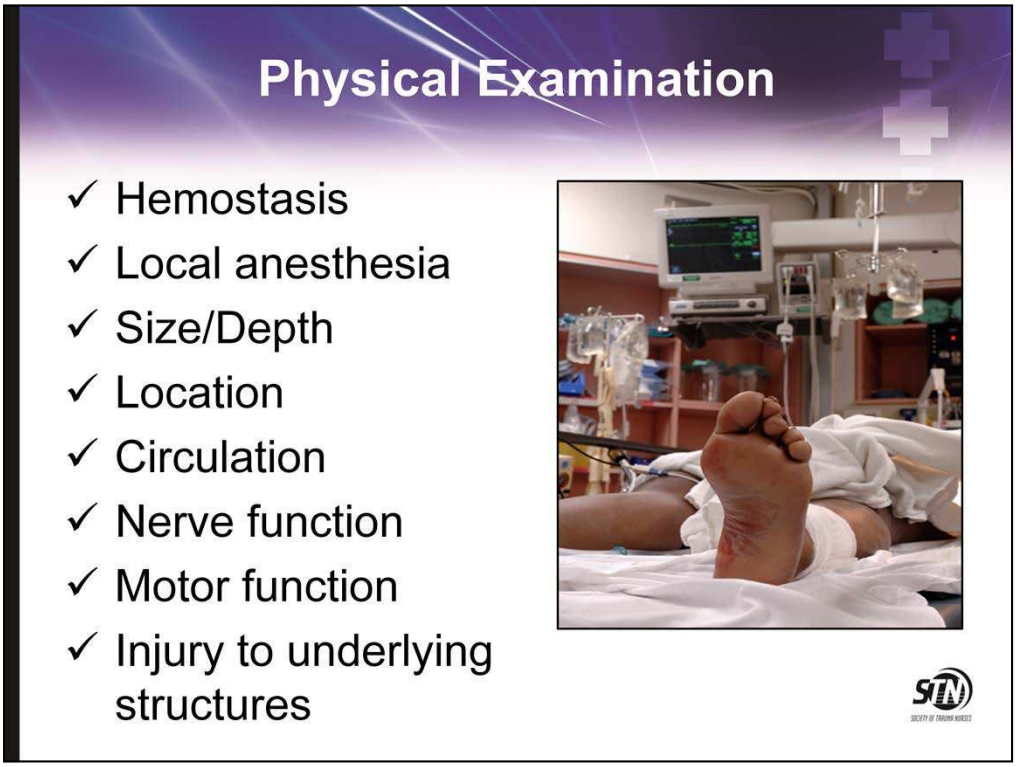
•Documentation of patient's symptoms is important and may provide clues to specific injuries.

•Does the patient experience paresthesia or loss of sensation

•These symptoms may represent a neurologic and or vascular injury

•Does the patient complain of severe pain? This may represent underlying fracture, foreign body, or serious medical condition (compartment syndrome, necrotizing fasciitis)

•Finally, potential for foreign body exposure must be determined.



•Physical examination must include size, depth, location, circulation, nerve and motor function, and injury to underlying structures.

•A thorough examination of a wound requires hemostasis and direct visualization into the depth of the wound.

•This often requires local anesthesia for patient comfort. However timing is controversial in relation to wound examination.

•Some advocate anesthesia and pain medication only once the wound has been examined to avoid masking sensory motor deficits.

•Careful and meticulous examination of a wound is critical to wound management.

•Examination begins with an adequate setting to include sufficient lighting to help identify foreign bodies as well as underlying nerve, tendon, vascular, and joint involvement.

•Depth:

•Typically, if deep structures are involved, the wound may not be a candidate for primary closure in the ED and may necessitate surgical exploration.

Circulation assessment:

•Presence of pallor or cyanosis

•Capillary refill

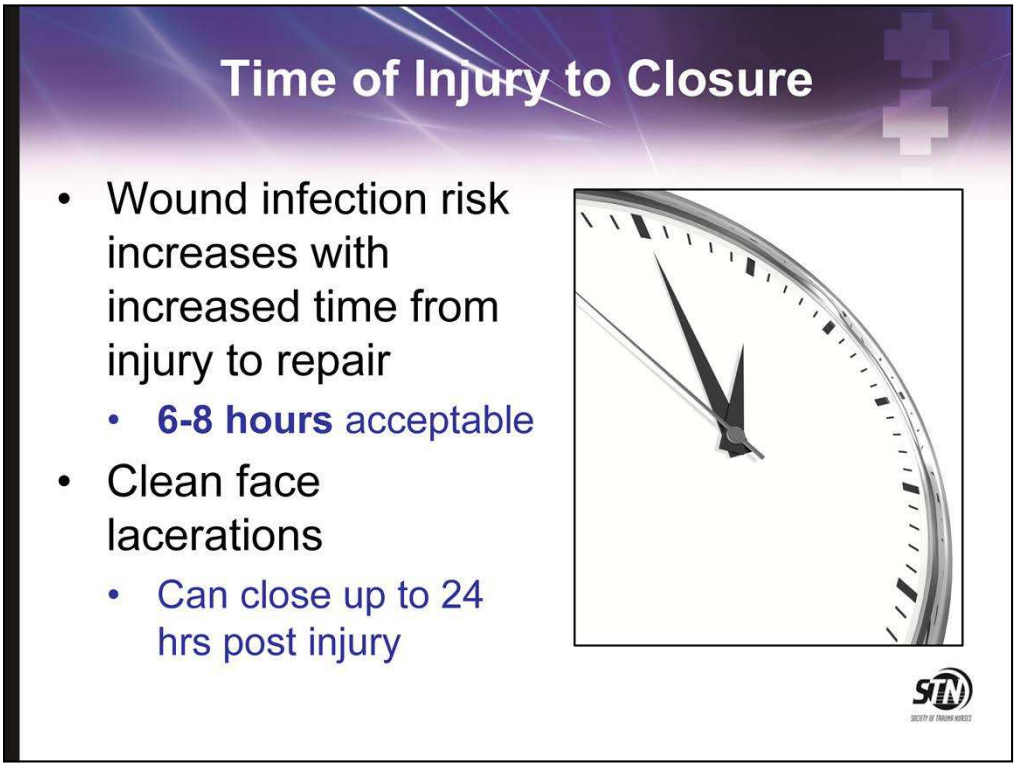
•Palpation of pulses distal to wound

Motor and Nerve Function

•Muscle groups, including flexor and extensor tendons, near the injury should be evaluated.

•Joints with overlying wounds should be completely flexed and extended with examination of the tendons through their full range of motion to assess for possible injury.

•Joint capsule penetration should also be identified because intraoperative evaluation, irrigation, and repair may be necessary.



•The time of injury is also crucial

•The potential for wound infection increases as the time increases between the injury and primary closure.

•The exact time frame depends on factors such as mechanism of injury, anatomic location, and patient risk factors.

•Clean lacerations of the face may he sutured up to 24 hours after the injury

•In contrast a diabetic with a 1 hour old contaminated wound requires urgent treatment.

•Anatomically, adult lacerations are more likely to occur on the head and neck and upper extremities, followed by trunk and then lower extremities.

•Children, are noted to have a greater percentage of facial lacerations, as compared to adults.

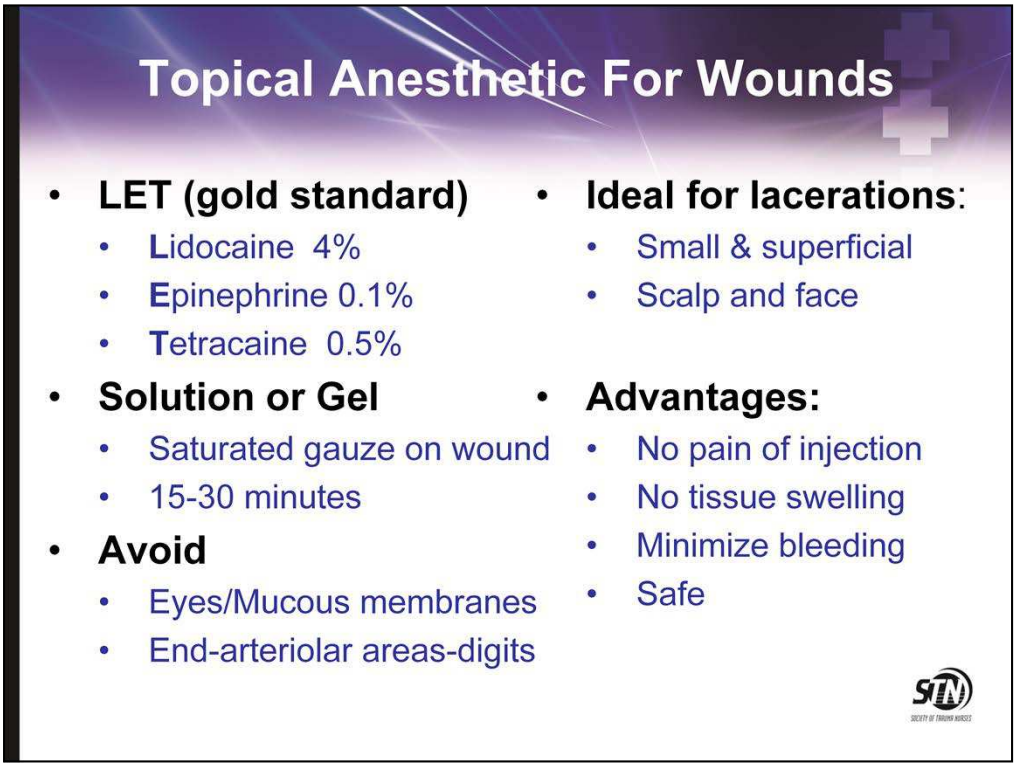
•Anatomical location of the injury is important because certain sites, such as the lower extremities, are much more prone to infection, especially when compared with lacerations on the face or scalp, which have improved regional blood flow

•The site of the wound also dictates the repair technique that would provide the best cosmetic result. The wound closure technique ultimately selected is primarily determined by skin tension and dynamics. Skin with less tension and dynamic forces, such as the face, usually result in smaller scars as do wounds that run parallel to the lines of skin tension. This is in contrast to lacerations over joints and those that run perpendicular to skin tension lines.

•The type of anesthesia used depends on the location and extent of the wound.

•Some form of anesthesia is generally required to permit adequate examination of the wound

•A full motor and sensory assessment is required **prior** to application of anesthesia



LET

•Topical anesthetic (lidocaine, epinephrine, and tetracaine [LET]) is in liquid or gel formulation applied directly to the wound.

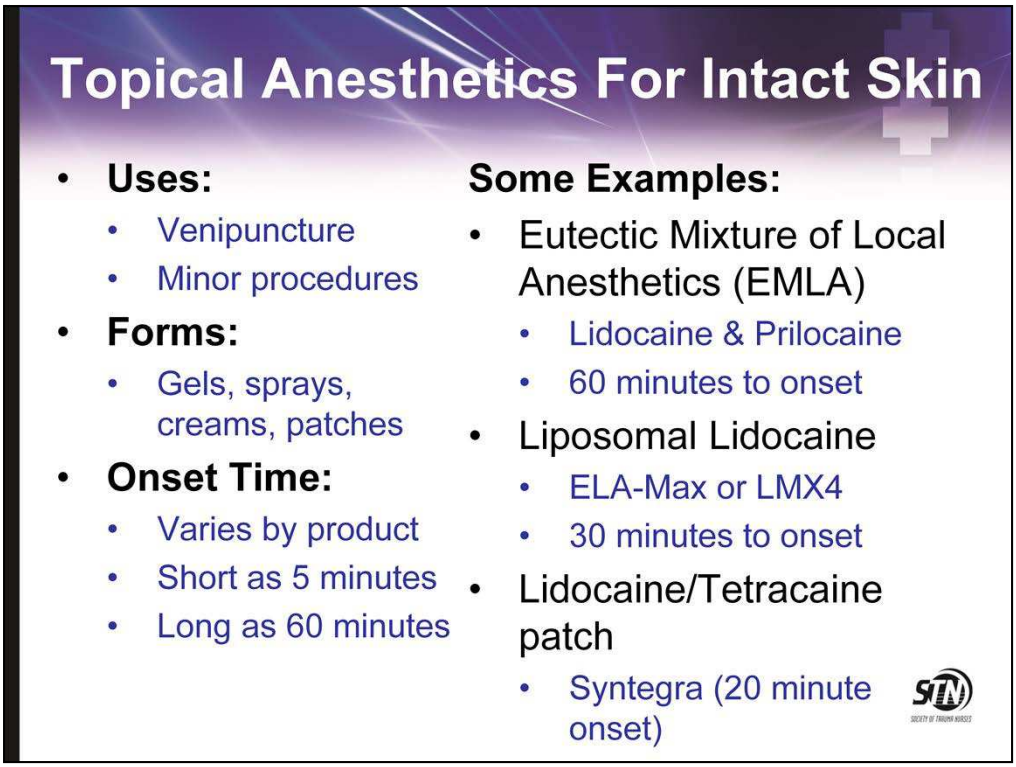
•This is to be distinguished from other ointments gels and sprays that are used on intact skin prior to venipuncture in pediatrics

•Apply by placing saturated gauze directly into the wound with firm pressure for 15-30 minutes.

•Onset 20 minutes

•Great for face and scalp lacerations, less effective on extremities

•No severe adverse side effects reported



Skin absorption of anesthetics is highly variable.

Many dosage forms exist (eg, gels, sprays, creams, ointments, patches) and provide the clinician with precise options for application under various circumstances.

Some Products Designed for Intact Skin Absorption:

EMLA

•Eutectic means (mixture that melts at lower temp) permitting higher concentrations of anesthetics.

•Mixture of Lidocaine and Prilocaine

•EMLA cream penetrates intact skin and provide analgesia of superficial layers.

•Depth of anesthesia depends on contact time

•Recent studies have shown that EMLA can also be effectively used on extremity lacerations.

•One study showed that 85 percent of children whose lacerations were treated with EMLA required no further anesthesia before suturing.

•The drawback is the 60 minute wait required between the application of EMLA and onset of laceration repair.

•Methemoglobinemia some times a side effect in infants

Liposomal Lidocaine

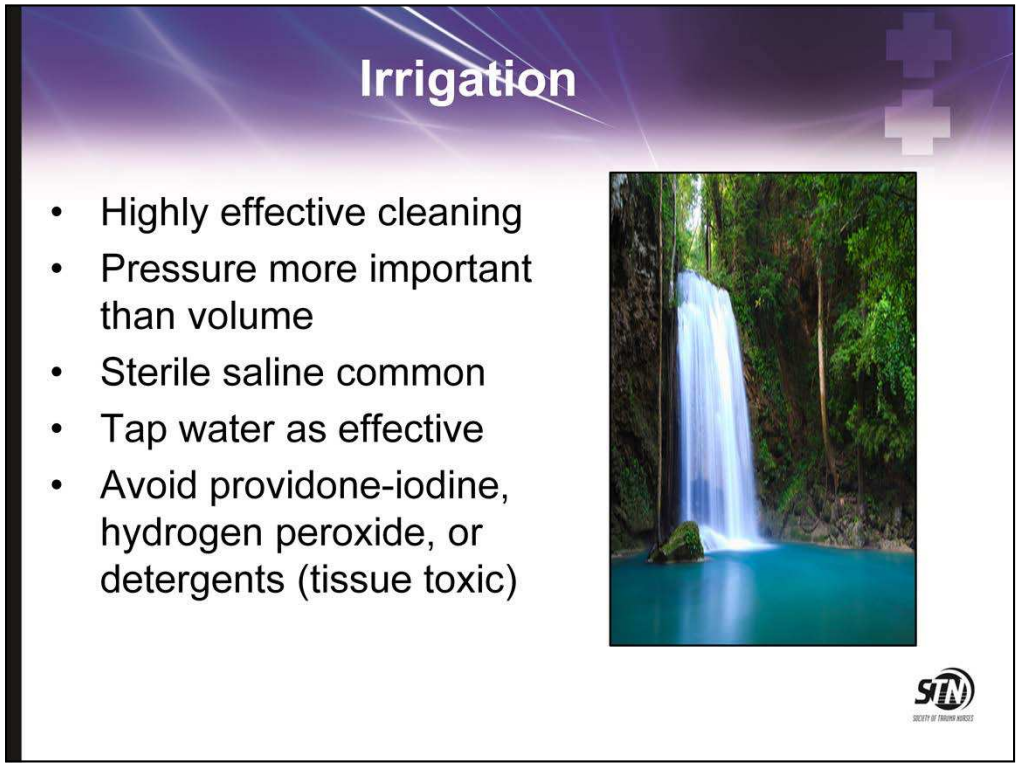
•Topical Liposomal Lidocaine (LMX-4) or ELA-Max offers a more rapid onset and less expensive alternative to EMLA.

•The liposome-encapsulated formulation protects the anesthetic from being metabolized too quickly.

•It is rapidly absorbed through the skin and within 20 to 30 minutes produces an anesthetic effect that is sustained for up to 1 hour after application.

•Liposomal lidocaine has the advantages of “needle-free” administration, a short onset of action and minimal vasoactive properties that minimize any potential interference with cannulation success.

•It is not associated with methemoglobinemia, a systemic side effect of lidocaine–prilocaine



Irrigation and Cleansing:

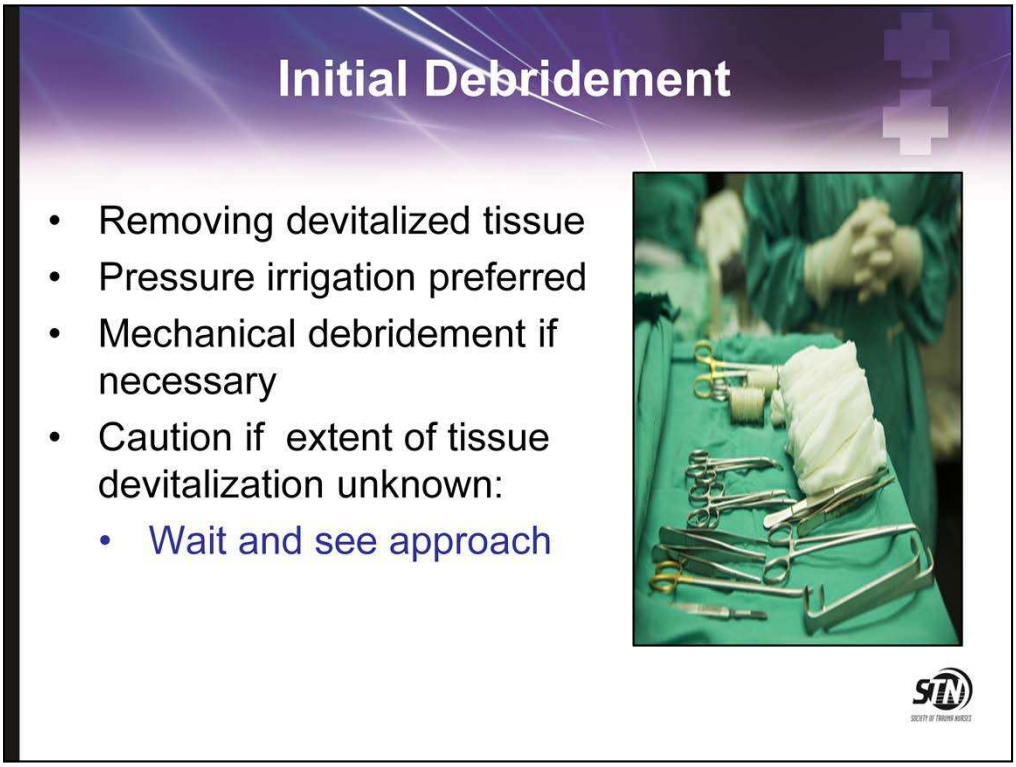
•Because the skin surrounding the wound can harbor bacteria, it is important to cleanse to remove any contaminants and dried blood.

•Scrubbing inside a wound has a potential for causing tissue damage.

•Irrigation is considered the most effective method of reducing bacterial counts and removing debris and contaminants on wound surfaces.

•The cleansing capacity depends on the hydraulic pressure under which the fluid is delivered.

•An effective method is to use a 35 cc syringe with an 18-gauge needle or catheter with the solution directed into the wound at an angle perpendicular to the wound surface and as close to the wound as possible



•Debridement is another means to improve healing, aesthetic outcome, and to decrease risk of infection.

•This is performed by removing devitalized tissue that is otherwise unable to resist infection.

•Methods of mechanical debridement include simple surgical excision as well as previously detailed “high pressure” irrigation.

If there is any question as to the extent of tissue devitalization, a “wait-and-see” approach may be considered to limit the amount of tissue excised.

Hair Removal

- Pros and Cons
- Removal to ease wound closure
- Others advocate presence of hair to assist guiding edge approximation
- Avoid eyebrow removal
  - Inconsistent regrowth

•Removal of the hair around wound sites has been associated with increased wound infection rates, thought to be secondary to the damage to intact skin from a razor. However, most studies have been done in the preoperative setting for elective surgery.

•Although some references will encourage hair removal to ease wound closure, others suggest that the presence of the hair assists as a guide in approximating wound edges

•Eyebrow removal is discouraged because regrowth doesn't consistently occur.

•Lubrication with antibacterial ointment to move hair away from the injury will sometimes assist in wound visualization and closure.

•X-ray is the first test to rule out foreign body

•CT scan most sensitive

•In studies of patients with hand wounds, nearly 38% had foreign bodies that were missed by the treating physician on initial wound inspection therefore liberal use of radiography is advocated.

•Retained foreign bodies are a source of significant litigation accounting for 14% of lawsuits and 5% of all legal settlements.

•If foreign body identified by imaging, wound exploration warranted within first 24 hours.

•Extraction is based on the type of object, its location, overall risk of infection and risk of complications with the removal process.

Contusion:

- Minor break in capillaries under the skin, allowing blood to escape and spread, causing the bruise to darken and spread.
- Nerve endings within the affected tissue detect the increased pressure, which, depending on severity and location, may be perceived as pain or pressure or be asymptomatic.
- The damaged capillary endothelium releases endothelin, a hormone that causes narrowing of the blood vessel to minimize bleeding.

Hematoma:

- localized collection of blood outside of a blood vessel, usually in liquid form within the tissue.

Crush Injury:

- The crush may only be a small part of the body but the effects can lead to acute renal failure and death if not treated
- Patients are at risk for rhabdomyolysis (release of skeletal muscle breakdown products) such as myoglobin, potassium and phosphorus into the blood stream.
- Rhabdomyolysis can lead to acute kidney failure due to the nephrotoxic metabolites of myoglobin.

Crush injuries are covered more extensively extensively in the Musculoskeletal Injury Chapter

Abrasions (friction mechanism)

•Abrasions are often referred to as road rash and are caused by friction such as dragging, rubbing or scraping.

•Superficial or partial thickness abrasions are very painful whereas full thickness abrasions are white and painless due to the damage of sensory nerves.

Contusions

Skin is not usually broken unless accompanied by a variety of other injuries. Extravasated blood tracks along natural traumatic planes of least resistance.

Hematomas

•Rupture of deep subcutaneous blood vessels

•Arterial hematomas accumulate at a more rapid rate and to a larger size than venous hematomas. Size is related to the capacitance of tissue where it forms. The thigh will hold several liters of blood accumulating from a hematoma.

Lacerations are, irregular tear-like wounds caused by some form of blunt or penetrating trauma.

Lacerations may appear linear (regular) or stellate (irregular).

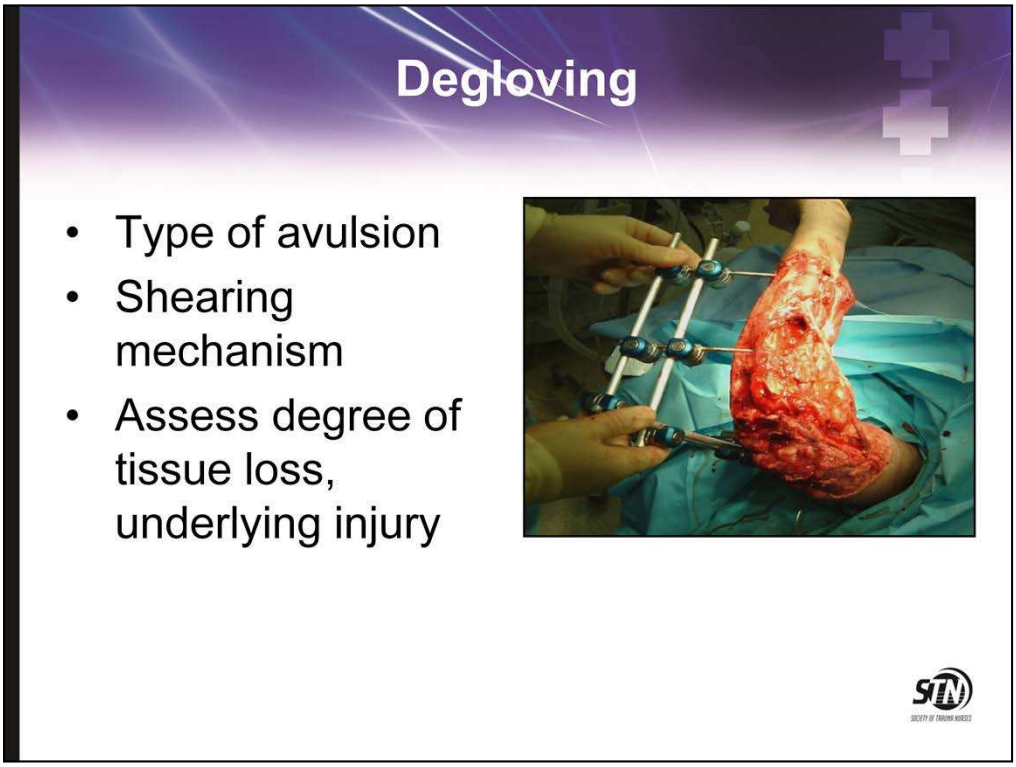
Closure depends on length and depth and degree of contamination.

Avulsion

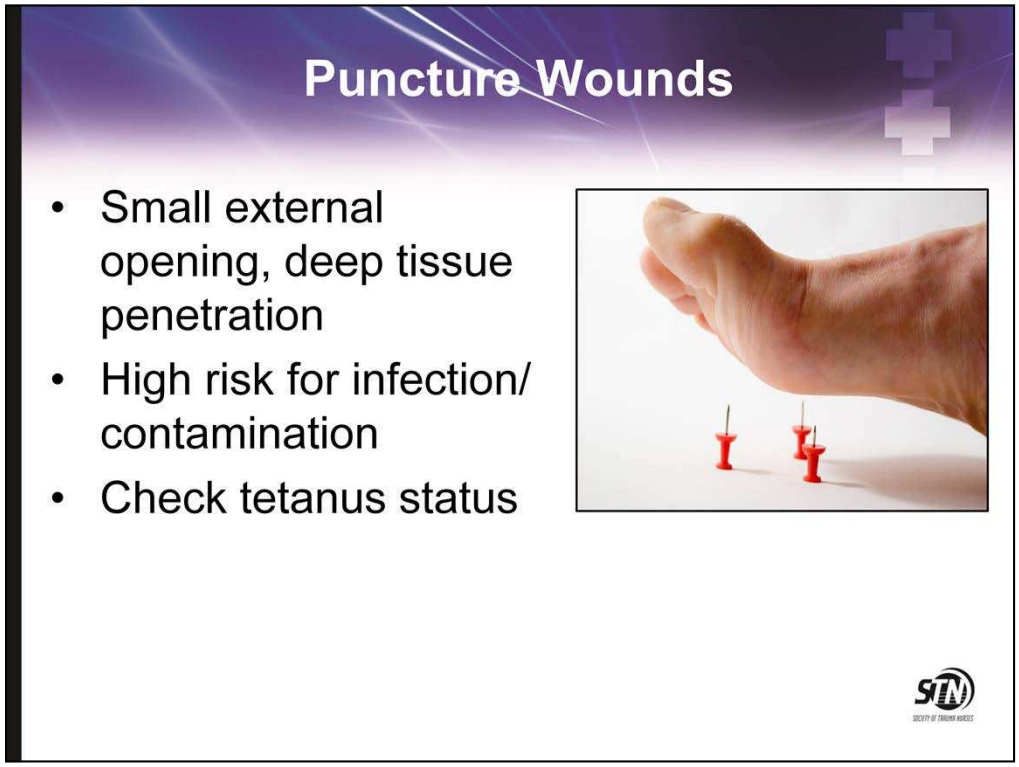
- Tearing, stretching mechanism
- Full thickness loss of tissue; wound edges cannot be approximated
- Assess degree of injury, underlying damage

The magnitude of an avulsion injury is often underestimated.

Usually changes occur within 24 hours, however, viability of tissue cannot be determined for up to 48-72 hours post injury.



Degloving is the removal of the skin from the underlying tissues in the same manner one removes a latex glove from your hand. Blood vessels connecting the dermis to the underlying muscle or periosteum rupture and necrosis.



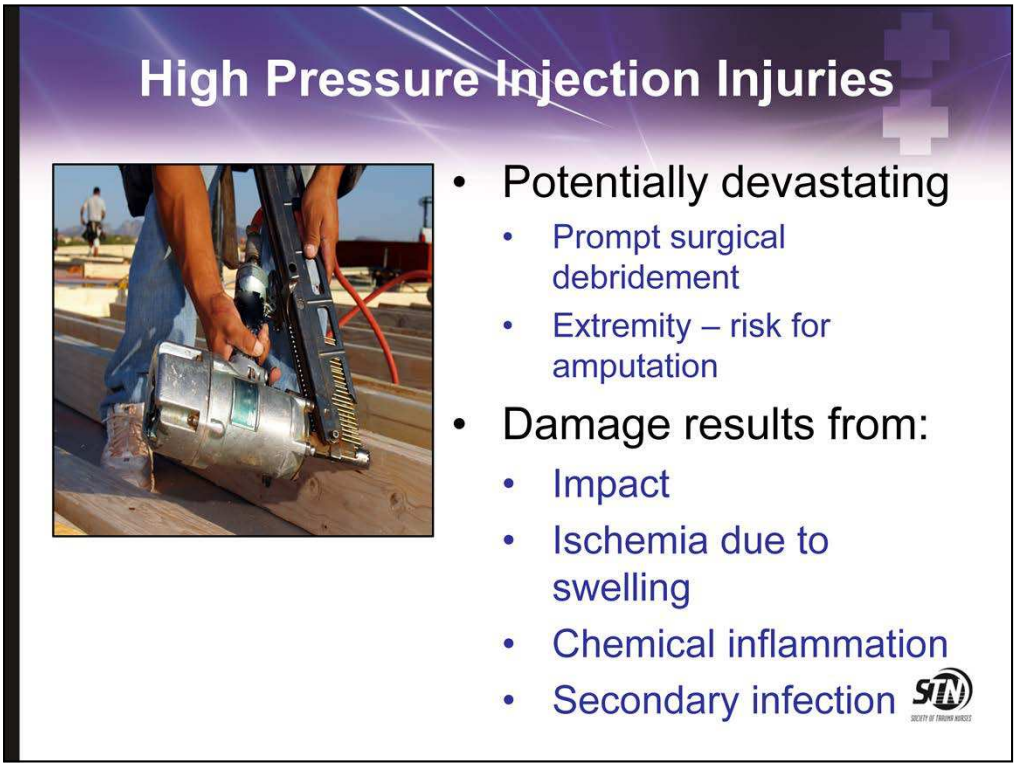
A puncture wound does not usually result in excessive bleeding.

Usually, these wounds close fairly quickly without any intervention.

Treatment may be necessary to prevent infection in some wounds.

A puncture wound from a cause such as stepping on a nail can become infected because the object that caused the wound may carry bacteria or spores (such as Clostridium tetani) that cause tetanus into the skin and tissue.

- **Infection** is the primary risk of bite wounds.
- Human bites are more infectious than animal bites.
- Dog bites, although wounds may appear larger due to teeth size, are less infectious than cat bites. r/o need for rabies vaccination or immune globulin
- The larger wounds provide an opening for bacteria to escape. Cat bites occur with needlelike teeth and create smaller wounds that will mend and not readily allow bacteria to escape.
- Incision and drainage may be necessary
- Culture wound
- Elevate injured area
- Follow within 24-48 hours
- Antimicrobial therapy



HIGH PRESSURE HAND INJURIES.

A wound that may not appear serious but with potentially devastating consequences

Most injuries result from grease guns, paint sprayers, or diesel fuel injectors.

The injury is caused by introduction of foreign material under high pressure.
“Damage results from the impact,

ischemia due to swelling, chemical inflammation and secondary infection.

Fuel and paint injections lead to the most severe inflammatory responses.

Overall incidence of amputation approaches 48%.

Wound Treatment General Concepts

No single treatment for entire healing process

- Antibiotics
- Debridement
- Dressings
- Surgical Closure
- Skin Grafts
- Skin Flaps
- Nutritional Support

Treatment of wounds will require continuous assessment and identification of treatment modalities as the wound progresses through the phases of healing.

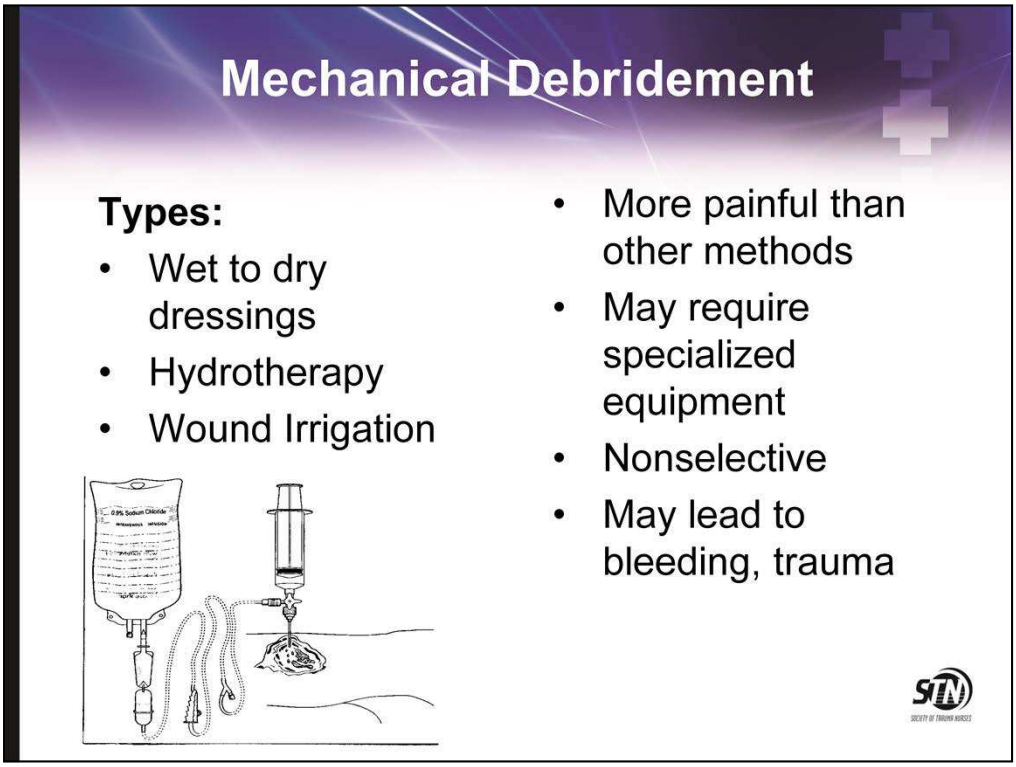
No single treatment will be optimal for the entire healing process; rather a combination of the following therapies will be required with the goal of preparing the wound bed to accelerate endogenous healing.

Each of these therapies in detail on the following slides.

•Antibiotic usage is most common in wounds with expected high bacterial counts such as seen in animal bites, soil contamination, crush injury, and stellate lacerations, which are all risk factors for infection

•In addition, it is also generally accepted that wounds involving normally sterile sites such as tendons, joints, or bones are at increased risk for infection.

•Finally, puncture wounds, intraoral lacerations, and most mammalian bites are considered to be infection-prone wounds.



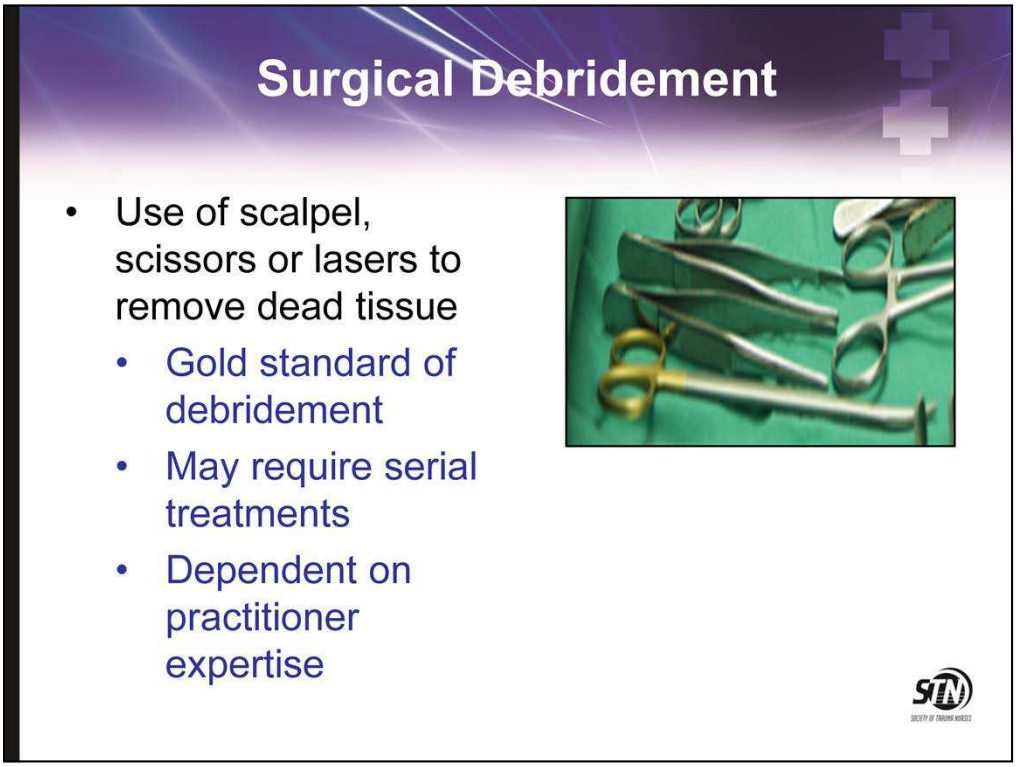
Debridement is the removal of necrotic tissue, bacteria and metabolic wastes to facilitate healing.

Mechanical debridement is employed with wet to dry dressings, hydrotherapy (or whirlpool) and wound irrigations. This type of debridement is reported to be more painful than other methods and may require specialized equipment to perform.

Mechanical debridement is nonspecific in its methodology- as it does not distinguish between necrotic or healthy tissue. This may cause disruption to the newly formed collagen matrix, bleeding and trauma to the wound bed.

Debridement is contraindicated on wounds that have poor perfusion (i.e.: heel wounds).

Hydrotherapy is contraindicated in granulating wounds as this will lead to maceration and injury to the wound bed. Some wounds can become larger with debridement.



The goal of debridement is to facilitate healing by removing the necrotic tissue, bacteria and metabolic wastes from the wound.

Surgical debridement is considered the **gold standard** of debridement.

The use of scalpel, scissors or lasers to remove necrotic tissue may be painful and require topical and systemic analgesics.

Large and complex wounds may require serial surgical procedures to completely debride.

Clinicians must be able to distinguish between healthy and necrotic tissue to prevent disruption of new cell growth.

Dressings

Type	Advantages / Considerations
Transparent 	-transmits moisture vapor; semipermeable to gases -no absorption capability -provides protection from friction -aids in autolytic debridement
Hydrocolloid 	-impermeable to gases and water vapor -provides moist environment -excessive granulation and maceration can occur
Hydrogel 	-water in a gel form -facilitates autolysis and removal of devitalized tissue -hydrates dry wound beds -may require daily changes

Selection of dressings should be based on individual patient assessment; taking into consideration the location of the wound, the amount of exudate, the presence of infection and if there is any necrotic tissue that requires debridement. The role of a dressing it to provide an optimal environment for the wound to heal. Using the same type of dressing throughout the entire healing process is not appropriate.

Transparent films are “see-through”, thin polyurethane membranes. These dressings mimic our skin by providing a moist environment. Most can be left in place for 7 days. Transparent dressings should not be used on wounds with exudate.

Hydrocolloid dressings are wafer like dressings that possess hydrophilic particles within the dressing that react with the exudate to form a soft gel over the wound bed. It is normal to notice a slight odor and residue in the wound bed upon removal of a hydrocolloid dressing. Excessive granulation and maceration of the wound can occur if this dressing is not changed appropriately and are not recommended for use on tunnels or sinus tract wounds.

Hydrogel dressings are designed water in a gel form and this environment facilitates autolysis in the wound bed. This matrix actually cools the wound by reducing the temperature of the wound bed. These dressings have a limited absorptive quality; thus should not be utilized in wounds with large amounts of exudate. Daily changes of the hydrogel dressing may be required to maintain moisture in the wound bed. The nurse should monitor and prevent maceration of the surrounding tissue.

Dressings

Type	Advantages / Considerations
Foam 	-highly absorbent, used in moderate to heavy exudate -permeable to gases and water vapor -can be used on infected wounds if changed daily -available with ionic silver
Calcium alginate 	-absorbent, non-adherent, biodegradable -forms a soluble alginate gel when in contact with wound drainage promoting moist wound bed -available in various sizes -requires a secondary dressing
Hydrofiber 	-forms a gel when interacts with wound fluid -maintains a moist environment -requires a secondary dressing -should not be used on dry wound or heavy bleeding

Foam dressings are made from a polyurethane and are highly absorbable. They are permeable to both gases and water vapor. Most can be used on infected wounds if changed frequently. Foam dressings can be utilized in combination with enzymes and topical agents.

Calcium alginate dressings are non-adhering and very absorbent. When they come into contact with wound drainage a soluble gel is created. This gel promotes healing by maintaining a moist wound bed. This type of dressing is contraindicated for third degree burns and dry wound beds, but can be used in bleeding wounds.

Hydrofiber dressings are made from sodium carboxymethylcellulose. This interacts with the wound exudate to form a gel which assists in maintaining a moist environment for wound healing. As with the calcium alginate dressing, hydrofiber dressings are contraindicated in third degree burns or dry wound beds. It should also be avoided in wounds with heavy bleeding.

Dressings

Type	Advantages / Considerations
Collagen 	-highly absorptive, hydrophilic (contains bovine) -can be used on granulating or necrotic wounds -changed every 7 days (daily if infected) -requires a secondary dressing
Composite 	-a combination of materials make up a single dressing -may adhere to wound bed: remove with caution -may be used on infected wounds -may facilitate autolytic debridement
Contact Layer 	-low adherence material of woven net -acts as a protective layer between wound and secondary dressing -used with ointments or other topical agents -not recommended for dry wounds or third-degree burns

Collagen dressings are derived from bovine hide and are highly absorptive and hydrophilic. These dressings can be used on granulating or necrotic wounds and should be changed a minimum of every 7 days. Collagen dressings will require a secondary dressing to secure in place.

Composite dressings contain a combination of materials to make up a single dressing. Although composite dressings are easy to apply, they may adhere to wound bed and cause trauma upon removal. They may be used to facilitate autolytic or mechanical debridement.

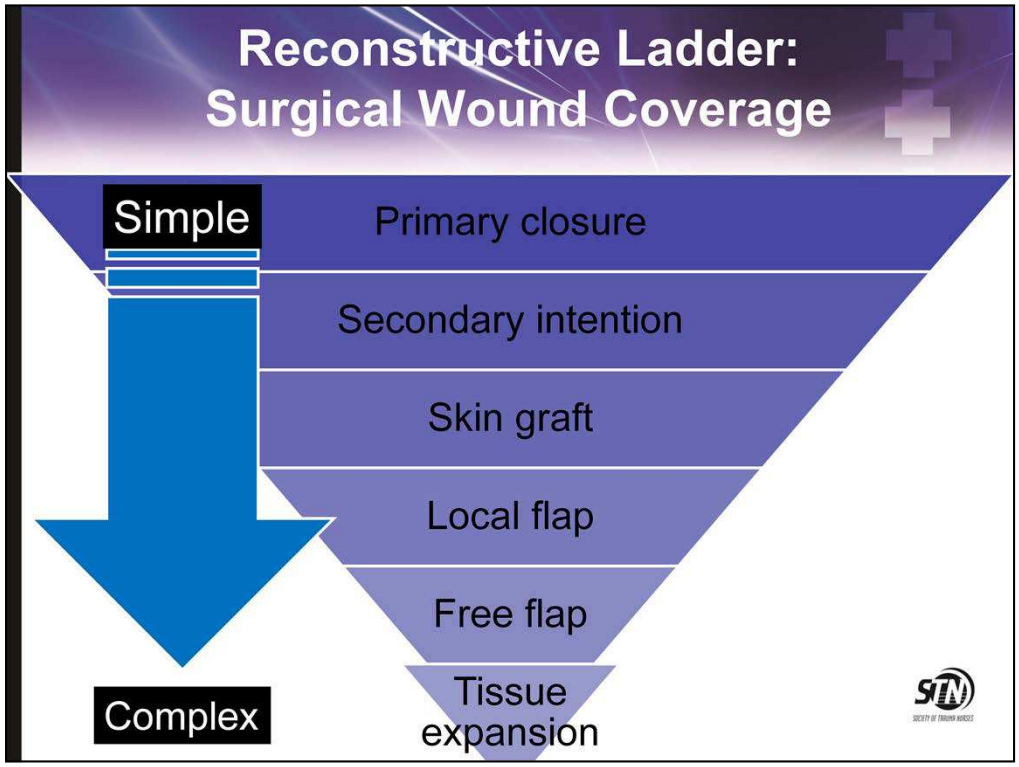
A woven net of low adherence material is a **contact layer dressing**. Once applied to a wound bed, a contact layer acts as a protective layer between the wound and a secondary dressing. Ointments, creams and other topical agents may be used in combination with this dressing as it allows exudate to pass through the contact layer and into the secondary dressing. This type of dressing is not recommended for dry wounds or third degree burns.

Dressings

Type	Advantages / Considerations
Gauze 	• can be used as packing, primary or secondary dressing • does not provide moist wound environment • may traumatize wound bed upon removal • requires frequent changes
Antimicrobial 	• provides antimicrobial effect against bacteria • available in a variety of forms (transparent, foam, fillers) • some may remain in place for 7 days • does not replace need for systemic antibiotics

Gauze dressings are still widely used for packing, primary and secondary dressings, but are no longer the standard of care for dressings. Gauze can impede healing, as it does not provide a moist healing environment. This dressing may be used as mechanical debridement as it removes tissue from the wound bed upon removal. As compared to some of the newer types of dressings, gauze dressings require more frequent changes which can be more painful for the patient and more labor intensive for nursing staff.

Antimicrobial dressings contain active ingredients such as silver ions or cadexomer iodine that provides an antimicrobial effect against bacteria. In addition, these dressings are available in a variety of forms and many can remain in place for up to 7 days. The use of antimicrobial dressings does not replace the use of systemic antibiotics in the fight against wound infections.



The reconstructive ladder is a term coined by reconstructive plastic surgeons to describe levels of increasingly complex management of wounds.

Provides a guideline for progression from simple (primary closure) to complex wounds (free flaps and tissue expansion).

The surgeon should start on the lowest rung and move up until a suitable technique is determined.

Primary closure provides for approximating and closing wound edges. This wound closure closing requires the use of sutures, staples, adhesive strips or glues. The type of closure is dependent upon location, configuration, tension applied to the wound and desired cosmetic effect.

Secondary and tertiary closures occur when primary closure can not be accomplished.

Secondary closure occurs by allowing formation of tissue granulation, contraction and epithelial migration in the open wound. There is a greater degree of scarring associated with this closure. Functional repair or cosmetic adjustments may be required at a later time.

Tertiary closure is also known as delayed primary closure. This method occurs when grafting or subsequent closure occurs after the wound bed is infection free and healthy granulation tissue has begun development. This approach is frequently utilized with contaminated wounds.

A skin graft is healthy skin used to replace or cover an area where skin has been damaged, lost or removed.

This skin is retrieved from a donor site. The graft consists of a section of skin including epidermis and dermis of varying thickness that has been separated from its blood supply and transplanted to cover a wound site.

Graft survival is dependent on the formation of new blood supply from the wound bed to the graft.

The graft will affix to the wound through the development of fibrin bonds. Revascularization occurs when the connecting tissues, capillaries and vessels establish a new circulatory system. Within 36 hours new blood vessels will begin to grow.

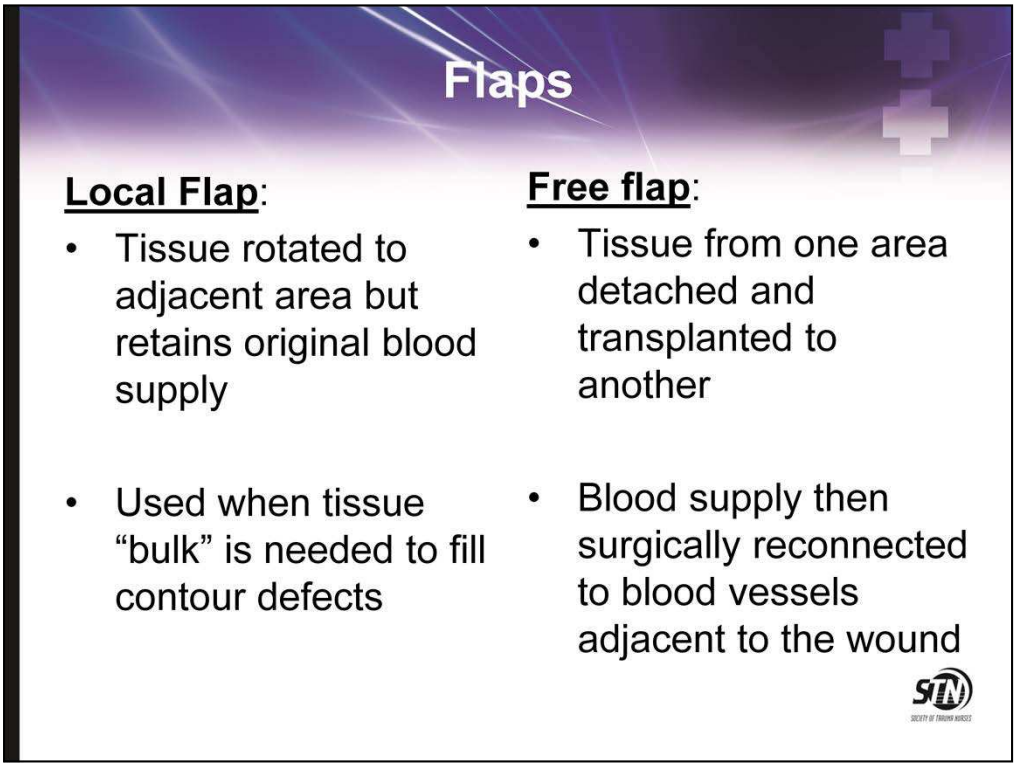
The injury will determine the length of time required for healing. Most grafts are successful, some my require additional surgical procedures.

Full thickness grafts can be utilized with significant tissue loss such as open fractures or following severe infections. These grafts are used for weight-bearing areas of the body. The full thickness graft will contain all layers of skin including blood vessels.

The most important part of the skin grafting procedure is proper preparation of the wound.

The wound must be free of dead tissue, foreign matter and bacterial contaminants.

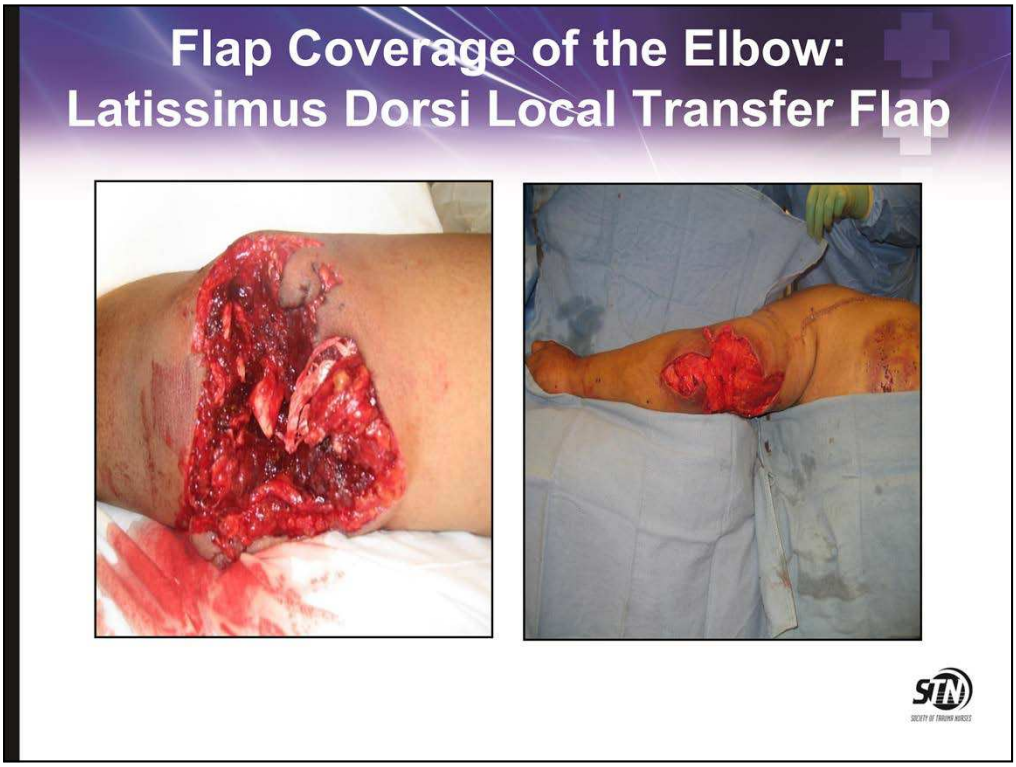
Prior to the graft application the wound is irrigated and debridement is performed, Following wound preparation the grafts are harvested and sized to fit the desired area.



Flap surgery is a piece of tissue that is still attached to the body by a major artery and vein or at its base.

This piece of tissue with its attached blood supply is used in reconstructive surgery by being set into a recipient site (injured area onto which a flap or graft is placed).

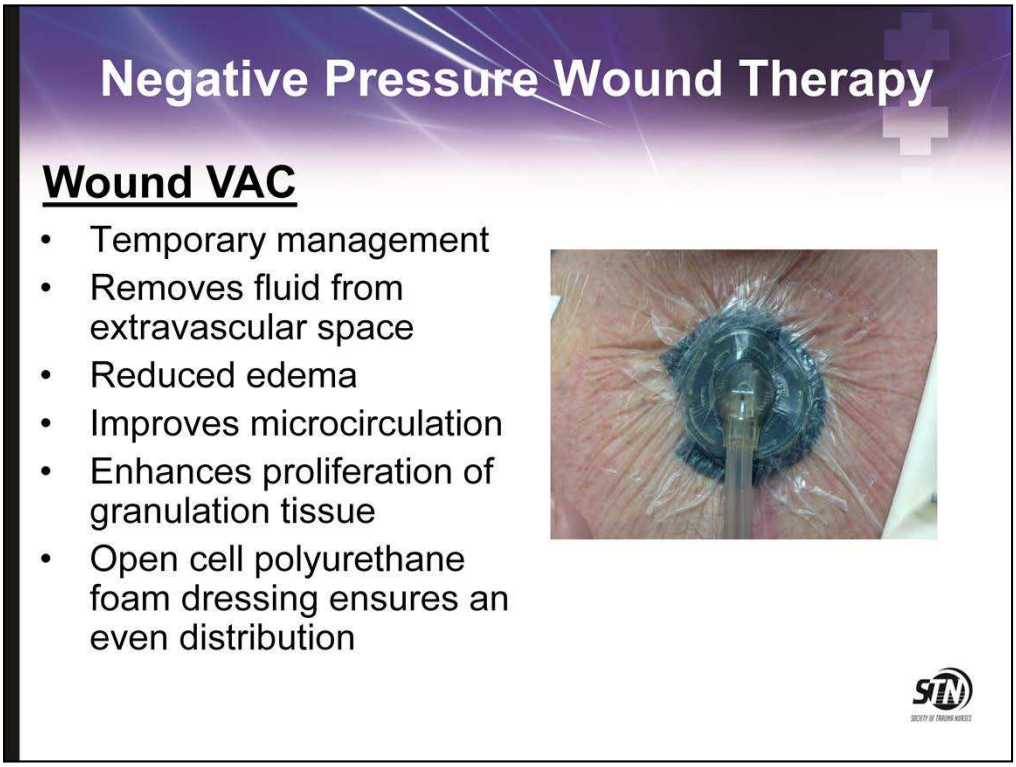
Used for trauma patients who have suffered tissue loss over any area of your body.



With a flap the surgeon removes tissue, including skin, fat, muscle, nerves and bone, from one part of the body and moves it to the part of the body where it is needed.

The arteries and veins are re-attached and, in some cases, the nerves are as well.

Local flaps are an exact match to tissue and the shape of the space it's being used for, in this case from the latissimus dorsi muscle of the back to the elbow.



Negative Pressure Wound Therapy (NPWT) is used in the three phases of healing in **acute and chronic** wounds.

NPWT works through fluid-based and mechanical processes

Negative pressure draws the edges of the wound together.

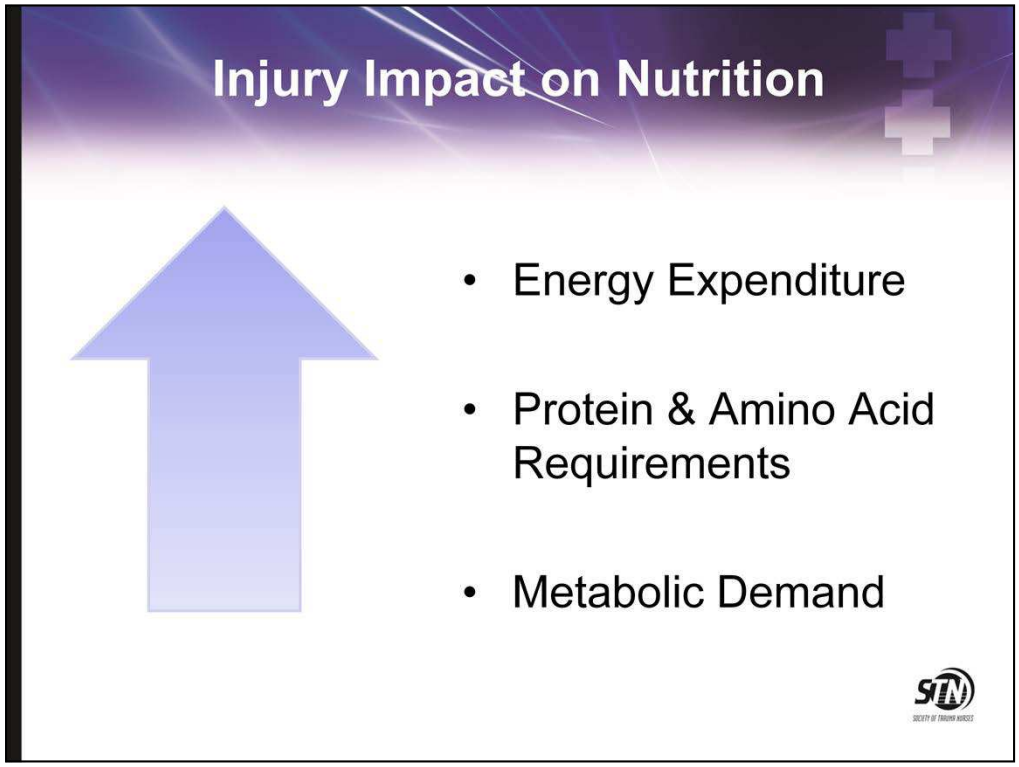
Stimulation of granulation tissue through the application of mechanical force slowly, stretching of the skin stimulates an increased rate of new cell growth and increases the formation of granulation tissue

Increased local blood flow improving perfusion, release of inflammatory mediators and removal of local edema. Increased blood flow also helps to remove bacteria from the wound. Continuous removal of exudate and. excess interstitial fluid around the wound margins increases capillary blood flow to the wound bed.

Reduction in the number of dressing changes decreases damage to delicate new tissue and decreases exposure of the wound to nosocomial infection.

Nursing Care:

Monitor for Bleeding: with or without using VAC Therapy, certain patients are at high risk for bleeding complications. These patients should be monitored every four hours for bleeding under the VAC transparent drape and in the VAC canister.



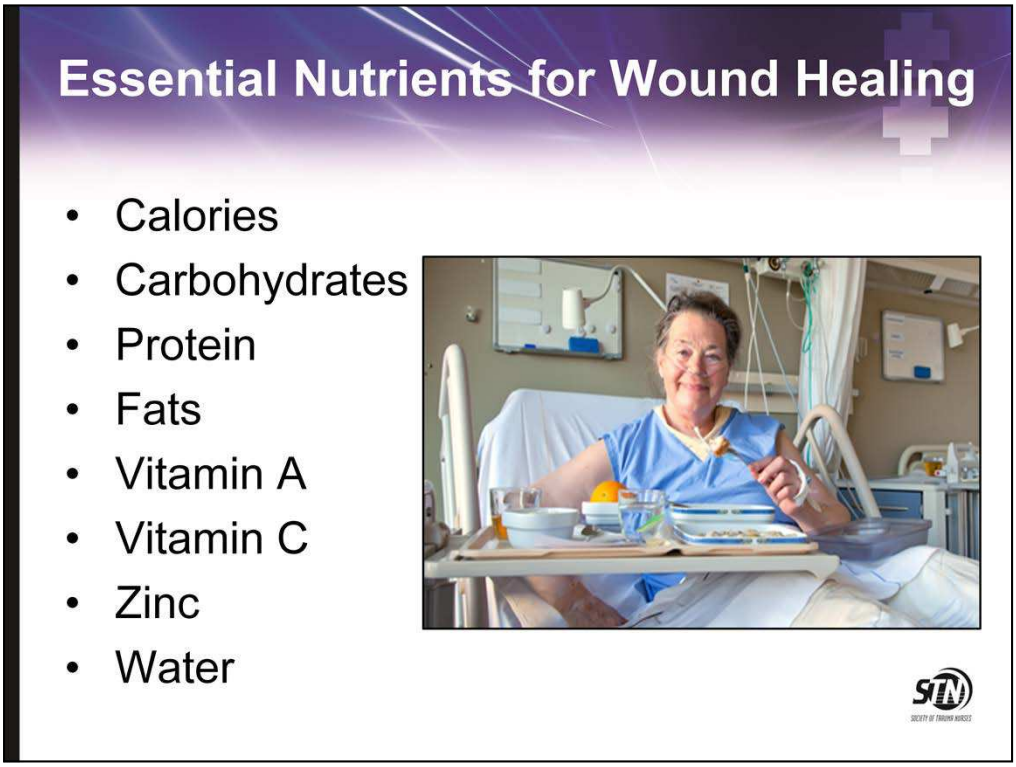
Due to extensive biological changes and metabolic demands after trauma, nutritional support and supplementation of essential proteins, vitamins and minerals is necessary for proper wound healing. The elements most in demand are those that contribute to collagen synthesis vital for growth of connective tissue.

Energy expenditures increase by as much as 10 -50% after major injury.

Protein and amino acid requirements increase

Because protein is broken down to promote energy.

In order to support the heightened metabolic demand nutritional support is extremely important.



Calories
- Increased by 25-30kg of body wt. daily to prevent loss of lean body mass

Carbohydrates
- Help to meet energy requirements
- Promote fibroblast movement, vital in wound healing
- Enhance WBC activity and support immune response

Protein
- Wound healing requires 1.5-3g per kg of body wt. per day
- Vital component of collagen synthesis

Fats
- Support cell membrane structure
- Should be 20% of calorie intake

Vitamin A
- Required for adequate inflammatory response
- Increases the strength of scar tissue

Vitamin C
- Potent antioxidant
- Important in the synthesis of enzymes that promote collagen production

Zinc
- Promotes DNA, cell division and protein synthesis
- Requirements increase during cell proliferation

Water
- Replacement of overt and insensible losses
- Post trauma requirement may range from 1500-2000ml/day

Summary

- Meticulous care of soft tissue injuries can have a tremendous impact on patient outcomes
- Utilization of appropriate measures during each phase of the healing process can prevent complications and promote normal healing process of soft tissues injuries