# SKIN

## Our Cloak and Protector at Risk

UNM- Health Sciences Center
Department of Pediatrics
Continuum of Care

Vera Asplund, BSN, RN

November 14, 2014

# Objectives

- The learner will be able to:

1. List the 3 phases of wound healing

2. List 3 risk factors which impact the healing of pressure ulcers

# Skin

- The skin is the largest  organ of the body and provides the interface between the body and the rest of the world
- The skin provides the first line of host defense mechanisms and protects the integrity and functioning of internal organ systems
- The psychosocial aspect of skin appearance is extremely important to a person's well-being

# Skin Characteristics and Functions

- Skin thickness ranges from 1/50 of an inch over the eyelids to 1/3 of an inch on the palms of the hands and the soles of the feet
- Specialized skin cells harden to form nails and elongate to form hair
- The pH of skin normally ranges from 4.5 to 5.5, thus providing the protective mantle of the skin, which serves to maintain the skin's normal flora

# Vital Functions of the Skin

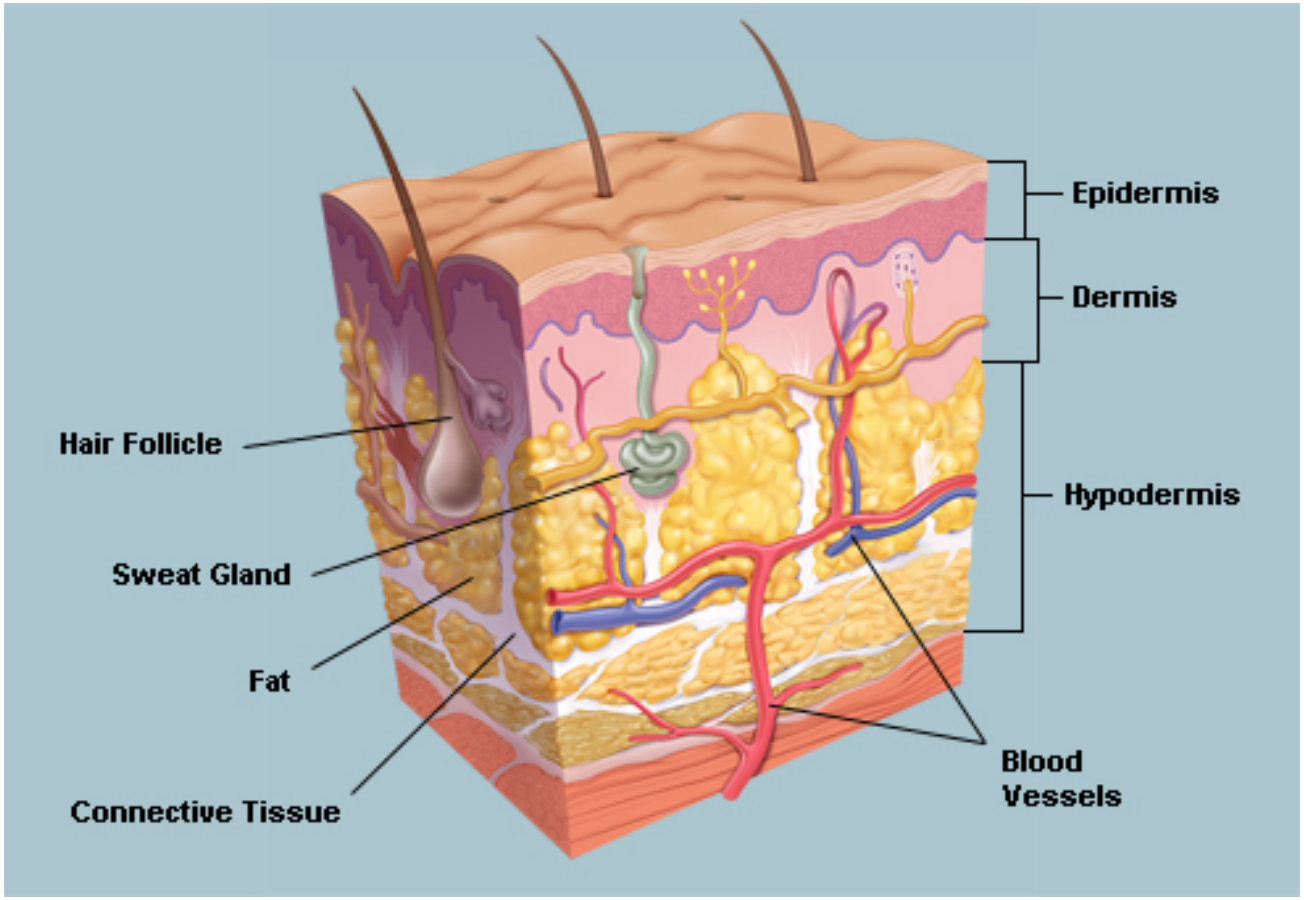
- Regulating body temperature
- Transmitting such sensations as touch, pressure, and pain
- Preventing excessive loss of body fluids
- Acting as an excretory organ
- Providing an interface between the body and its environment
- Protecting the inner tissues from invasion

# Skin Layers- Epidermis

- Outermost layer of skin, which is thin and avascular
- Further divided into five structurally and functionally distinct layers
  - Stratum corneum
  - Stratum lucidum
  - Stratum granulosum
  - Stratum spinosum
  - Stratum germinativum (basal layer)

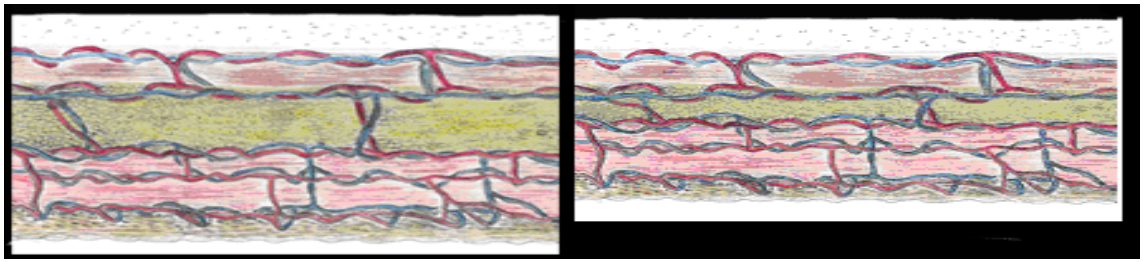
# Skin Layers
# Dermal-Epidermal Junction

- The dermal-epidermal junction provides structural support and allows exchange of fluids and cells between the skin layers
- The epidermis has an irregular surface, with downward fingerlike projections known as rete ridges or pegs
- These pegs of epidermis interface with upward projections of the dermis anchoring the epidermis to the dermis


Epidermis
Dermis
Hypodermis
Hair Follicle
Sweat Gland
Fat
Connective Tissue
Blood Vessels

# Skin Layers
# Dermal-Epidermal Junction

- As the skin ages, this dermal-epidermal junction tends to flatten, as the contacting surfaces of epidermis and dermis decrease by one-third
- This loss increases the potential for dermal-epidermal separation and places older people at risk for skin tears



# Skin Layers
# Dermis

- The layer of skin lying beneath the epidermis. It is highly vascular, tough connective tissue, containing nerves, lymphatics, sebaceous glands, and hair follicles.

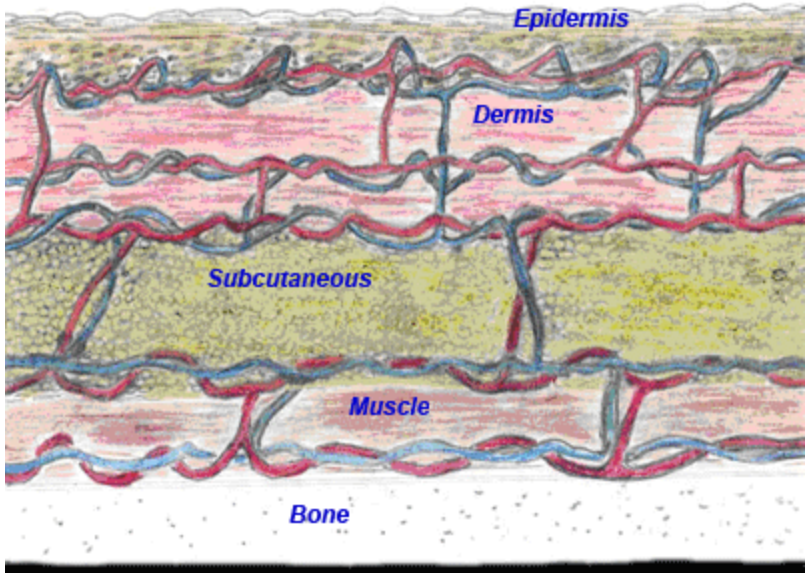
# Skin Layers
# Subcutaneous Tissue

- This layer is made up of dense connective and adipose tissue
- It houses major blood vessels, lymphatics, and nerves; acts as a heat insulator; and provides a nutritional depot that is used during illness or starvation
- The subcutaneous fat also acts as a mechanical shock absorber and helps the skin move easily over the underlying structures

# Skin Layers
# Fascia

- Below the subcutaneous layer is a layer of superficial fascia, a type of dense, firm, membranous connective tissue which connects the skin to subjacent parts and facilitates movement

# Normal Skin



# Blood Supply

- The vasculature of the dermis is the most expansive of any organ system
- The main purpose of this vast blood supply is to regulate body temperature
- The skin is oversupplied with blood when compared with its metabolic needs
- Muscle and fatty tissue do not tolerate ischemia or hypoxia, and are more susceptible to the effects of pressure than are the dermis and epidermis

# Age-Related Changes

- Sweat glands diminish in number
- Epithelial and fatty layers of tissue atrophy and become thin
  - Thickness of subcutaneous fat on the legs or forearms diminishes, even if abdominal or hip fat remains abundant
  - The general loss of fat from the subcutaneous tissue results in the relative prominence of the bony protuberances

# Age-Related Changes

- Collagen and elastin shrink and degenerate
  - Collagen content of the skin decreases by approximately 1% per year throughout adult life

- The net effect of all these changes is thin, dry, and inelastic skin that is increasingly susceptible to separation of dermis and epidermis as minor friction or shearing forces cause an injury known as skin tear

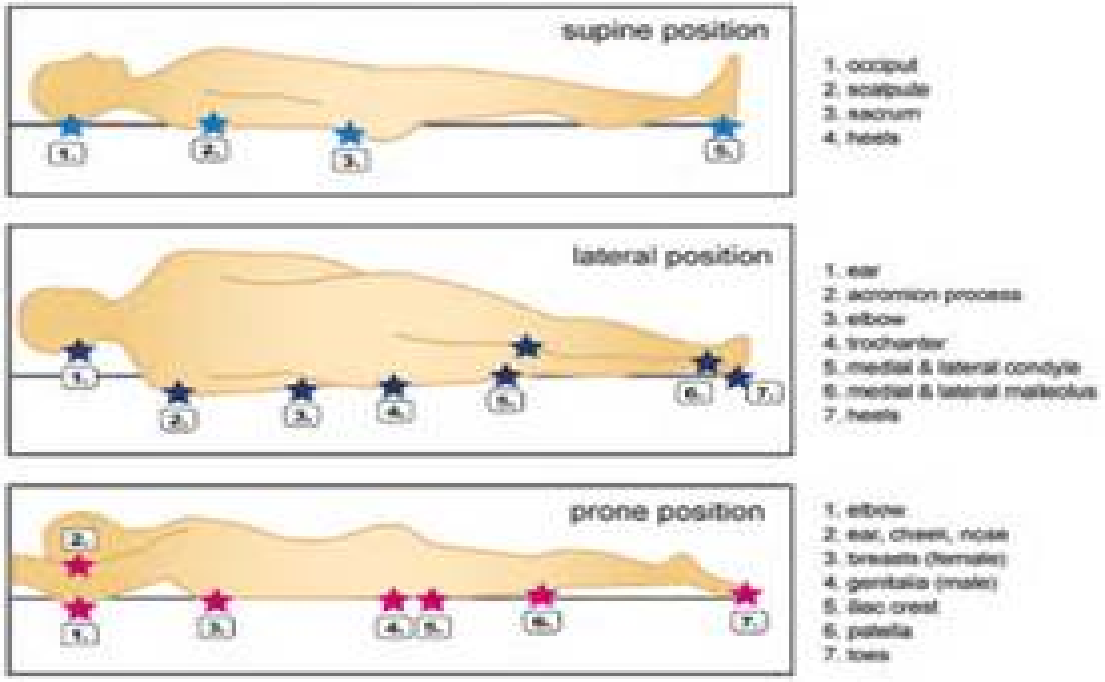
# Pressure Ulcer Defined

- The National Pressure Ulcer Advisor Panel (NPUAP) in the United States defines pressure ulcers as follows:
  - A pressure ulcer is localized injury to the skin and/or underlying tissue usually over a bony prominence, as a result of pressure, or pressure in combination with shear

# Etiology of Pressure Ulcers

- Pressure ulcers usually occur in soft tissue over bony prominences that remain in contact with compressing surfaces
- Many other factors—primarily shear, friction, excessive moisture, and possibly infection—interact to mechanically damage soft tissue
- When the soft tissue is subject to prolonged pressure and insufficient nutrients the result is cell death

# Common Pressure Points



# Pressure

- Muscle is more sensitive to compression than skin
- The deeper muscle tissue may be necrotic before damage to the overlying skin is apparent
- The force of pressure increases as the affected body surface area decreases

# Time-Pressure

- The normal response to prolonged pressure is a change in body position before tissue ischemia occurs
- Low pressure endured for long periods of time is believed to be more significant in producing pressure ulcers than higher pressure of short duration
- If the time-pressure threshold is reached or exceeded, tissue damage continues even after pressure is released

# Time-Pressure

- Pressure ulceration can result from one period of sustained pressure
- Most pressure ulcers occur secondary to repeated ischemic events without adequate time for recovery

# Bony Prominences

- Pressure ulcers can form over any bony prominence or any area of soft tissue that is subjected to prolonged pressure

- Sacrum
- Coccyx
- Ischial tuberosities
- Greater trochanters
- Elbows
- Heels
- Scapulae
- Occipital bone
- Sternum
- Ribs
- Iliac crests
- Patellae
- Lateral malleoli
- Medial malleoli

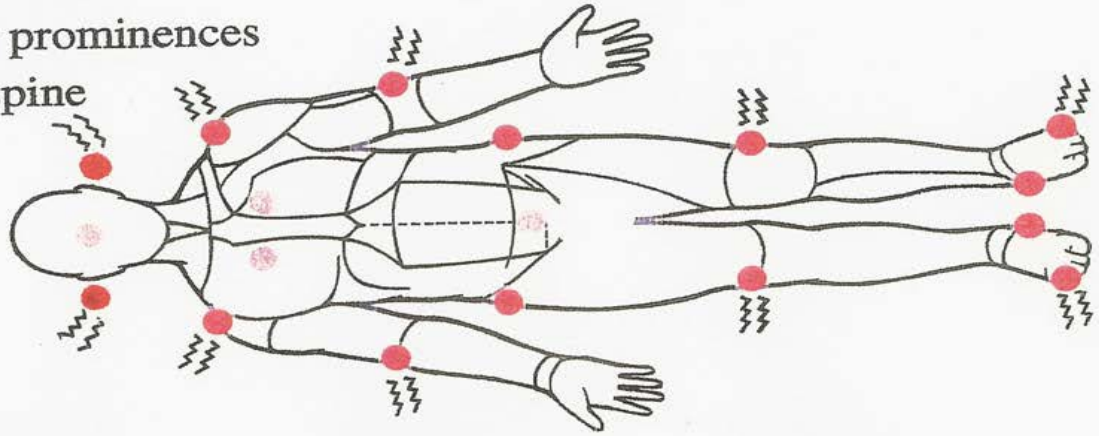
# SKIN ALERT

## *Stop, Check, Document*

**H** eels
**O** cciput
**T** oes

**S** acrum
**P** osterior buttock
**O** ver bony prominences
**T** horacic spine
**S** capula

STOP
CHECK HOT SPOTS
INFORM
DOCUMENT

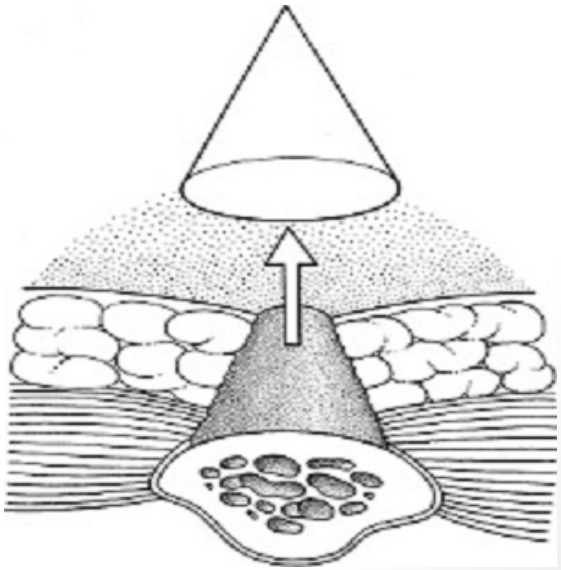


# Contractures

- Untreated contractures may cause pressure ulceration
- A contracted limb may exert pressure on adjacent areas other than bony prominences
- A contracted limb may exert more pressure on the mattress than does a non-contracted limb

# Pressure Gradient

- When blood vessels, muscle, subcutaneous fat, and skin are compressed between bone and the surface where an individual is lying or sitting, pressure is transmitted from the body surface toward the bone, and the bone exerts counter pressure. *These opposing forces result in a cone-shaped pressure gradient.*



# Pressure Gradient

- Pressure affects all of the tissue between the external surface and the skeletal anatomy, but the greatest tissue destruction is at the bony interface
- *The wound one observes may be just the tip of the "iceberg."*
- Because fat and muscle have little tolerance for decreased blood flow, they are less resistant than skin to pressure

# Pressure Gradient

- Destruction in the subcutaneous tissues and muscle may be far worse than the surface damage indicates

- Assessment of pressure ulcer size must take into consideration the presence of unseen necrosis in the area of the pressure gradient

# Wound Healing

- Primary intention healing occurs when a wound has little or no tissue loss and margins are approximated using simple methods or with sutures

- Delayed primary intention healing occurs when significant tissue loss can be repaired surgically with a skin or muscle graft or flaps

- Second intention describes the process of healing a wound without the benefit of surgical closure

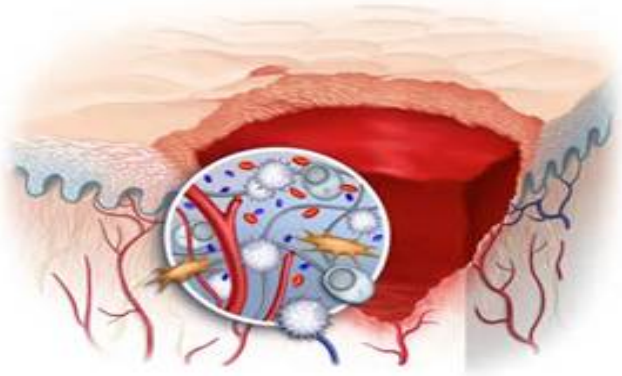
# Wound Healing

- *The process of wound healing begins at the moment of injury and may continue for years*

- No matter how trivial or extensive the wound, healing always includes three overlapping phases:  inflammation, proliferation, and differentiation

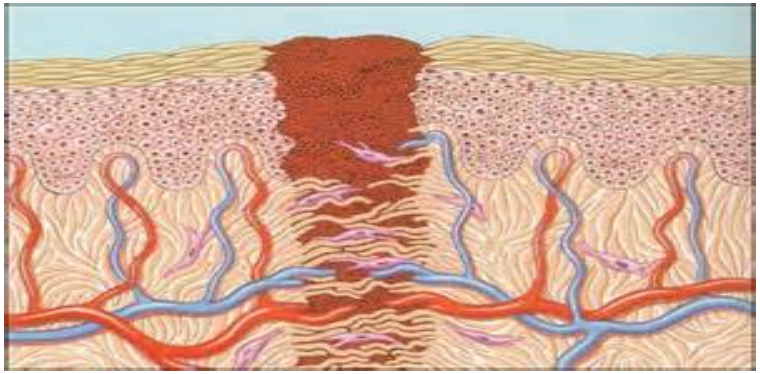
# Inflammatory Phase

- The main function is to initiate the wound-healing cascade, remove the debris, and prepare the wound for the regeneration of new tissue
- The inflammatory phase is characterized by local erythema, edema, and tenderness



# Proliferative Phase

- The proliferative phase of wound healing overlaps the inflammatory phase
- It begins 2-4 days after wounding and lasts for approximately 15 or 16 days
- *The main events during this phase are deposition of connective tissue and collagen cross-linking which fills the wound with collagen and provides strength*



# Proliferative Phase

## Granulation

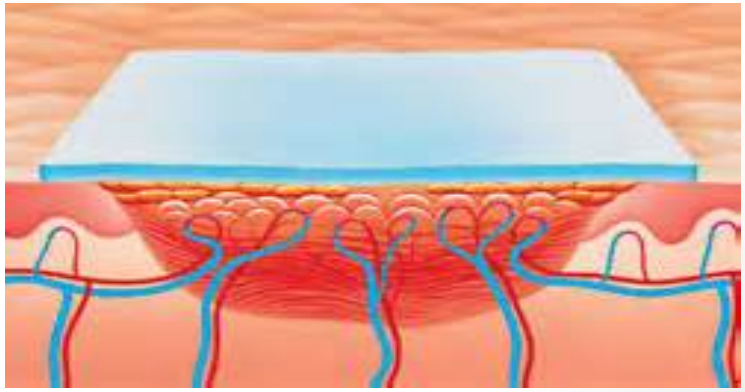
- During collagen production, new capillaries are forming as budlike structures
- Capillaries penetrate the wound and carry nutrients to the newly generating tissue
- Granulation tissue, when kept moist, provides good tissue for advancing epithelial cells

# Proliferative Phase
## Granulation

- As the wound matures, the synthesis of collagen decreases, the new vascular channels regress, the wound  transforms to a comparatively avascular, and cell-free scar tissue composed of dense collagen bundles

# Epithelization

- Epithelial cells migrate from the wound margins across the wound surface to create a watertight seal over the wound
- Fibrin strands functions as a scaffolding over which the cells creep
- Sheets of new epithelial cells continue to grow until they come into contact with others moving across the wound from other directions



# Epithelization

- Primary healing —fibrin closes the wound within a few hours and epithelization begins in 1-2 days
- Secondary healing —migration of cells is rapid at first but gradually slows—days or weeks may elapse before epithelization is complete
- If a scab is covering the wound surface, the epithelial cells must migrate underneath the scab

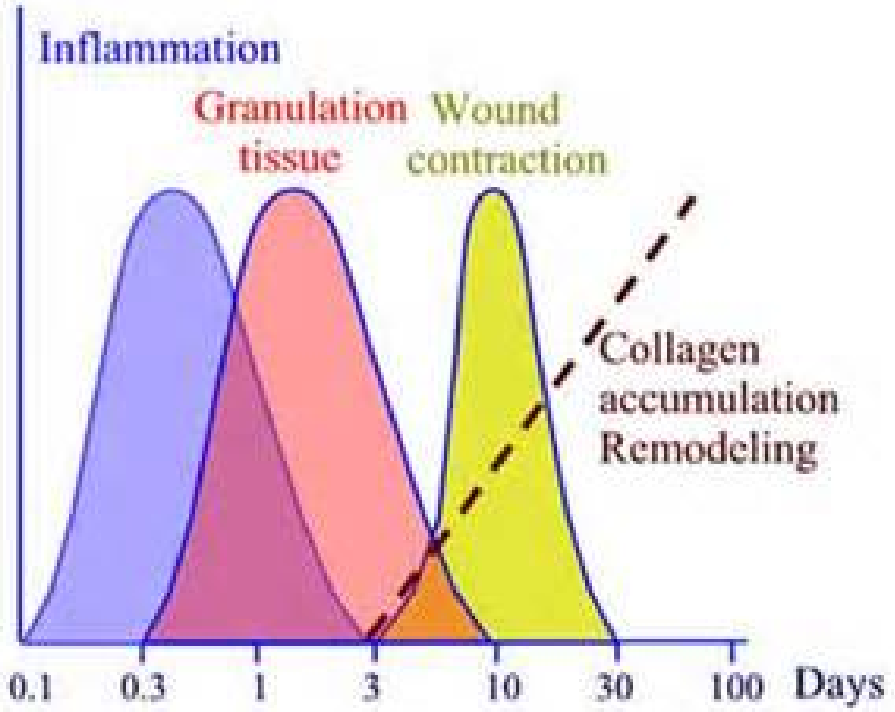
# Contraction

- The scar in a wound that has healed by secondary intention shrinks by a process called wound contraction
- It begins on about the fifth day
- Secondary intention healing continues for months or even years

# Differentiation Phase

- The wound matures and the collagen in the scar undergoes repeated degradation and resynthesis
- This is the longest phase of wound healing
- The tensile strength of the scar increases
- Between the 1st and the 14th day, tissues regain approximately 30% to 50% of their original strength
- Tensile strength continues to increase to approximately 80% of normal tissue strength
- Wounds never completely regain the tensile strength of unwounded tissue

# Phases of Wound Healing




Orderly phases of wound healing

# Factors Affecting Healing

- Healing is influenced by systemic conditions or by local conditions in the wound
  - Tissue oxygenation
  - Stress
  - Advanced age
  - Nutrition
  - Infection

# Tissue Oxygenation

- Oxygen is essential for wound healing
- Blood flow supplies the wound with oxygen and nutrients
- Blood flow removes carbon dioxide and metabolic by-products
- *Any condition that reduces blood flow to a wound, such as arterial occlusion, vasoconstriction, or external pressure impedes healing*

# Stress

- Sympathetic nervous system and adrenal responses to stress (i.e. neural, hormonal, or metabolic changes) can impair wound healing
- A plan that provides sleep and rest for the patient with a pressure ulcer will promote wound healing



# Advanced Age

- Aging affects almost all aspects of the healing response
- Slowing epidermal turnover and increasing skin fragility together reduce wound healing by a factor of four
- The repair rate declines with:  falling rates of cell proliferation, lack of development of wound tensile strength, impaired collagen deposition and wound contraction

# Advanced Age

- Medical conditions occur in many elderly persons which adversely affect healing
- The elderly tend to be malnourished and poorly hydrated, and have compromised respiratory and immune functions
- Loss of dermal and subcutaneous mass increases the risk for pressure-induced tissue injury

# Malnutrition

- Wound healing and the immune response both require an adequate supply of various nutrients, including protein, vitamins, and minerals
- Loss of more than 15% of lean body mass interferes with wound healing
- Individuals with chronic wounds may need more protein and calories than the recommended daily allowances and may require dietary supplements

# Protein

- Low serum albumin levels are a late manifestation of protein deficiency
- Serum concentrations below 3.0 g/dl are an indicator of poor nutritional status
- Serum concentrations below 2.5 g/dl reflect severe protein depletion

# Vitamins & Minerals

- Vitamin C
  - Deficiency is associated with impaired fibroblastic function and decreased collagen synthesis which delay healing and contribute to breakdown of old wounds
  - Deficiency causes loss of resistance to infection
  - Is water-soluble and cannot be stored in the body

# Vitamins & Minerals

- Vitamin A
  - Associated with retarded epithelialization and decreased collagen synthesis
  - Deficiency is uncommon because it is fat-soluble and is stored in the liver
- Other vitamins, such as thiamine and riboflavin, are also necessary for collagen organization and the resultant tensile strength of the wound
- Various minerals, such as iron, copper, manganese, and magnesium play a role in wound healing

# Nutritional Risk Factors

- Dental health
- Oral and GI history
- Chewing and swallowing ability
- Quality and frequency of foods eaten
- Involuntary weight loss or gain
- Serum albumin levels
- Nutritionally pertinent medications
- Psychosocial factors affecting nutritional intake

# Nutritional Risk Factors

- Laboratory tests—depressed serum protein, serum albumin, and transferrin levels together indicate poor nutritional status
- Body weight—
  - At-risk patients should be weighed weekly
  - Notify a physician, nurse, or dietitian if there is an unintended loss of 10 pounds or more during any 6-month period
  - A change of 5% of body weight is predictive of a drop in serum albumin

# Infection

- Debridement, drainage, and removal of the necrotic tissue alone controls most infections
- Open wounds do not have to be sterile to heal
- Healing cannot proceed until all necrotic tissue has been removed from the wound
- Parenteral antibiotics are indicated only when signs and symptoms suggest cellulitis, sepsis, or osteomyelitis

# Infection

- Ulcer infection
  - Is recognized by the classic signs of redness, fever, pain and edema
  - The cardinal sign is advancing cellulitis

- Sepsis
  - May originate from infected pressure ulcers of any stage
  - Blood culture is the only way to identify the pathogen

# Infection

- Osteomyelitis (infection involving the bone)
  - Is likely in stage IV ulcers
  - Delays healing, causes extensive tissue damage, and is associated with a high mortality rate
  - A bone biopsy and culture are necessary for diagnosis
  - If the patient's white blood cell count, erythrocyte sedimentation rate, and plain X-ray are all positive, osteomyelitis is likely

# Barriers to Healing

- Corticosteroids—
  - Suppress the inflammatory response; inflammation is necessary to trigger the wound-healing cascade
  - Steroid therapy begun after the inflammatory phase of healing (usually 4-5 days after wounding) has a minimal effect on wound healing

# Barriers to Healing

- Smoking

  - Nicotine interferes with blood flow:
    - Is a vasoconstrictor
    - It increases platelet adhesiveness—causing clot formation
  - Cigarette smoke is a vasoconstrictor, and contains carbon monoxide and hydrogen cyanide

# Barriers to Healing - Diabetes

- High levels of glucose compete with transport of ascorbic acid, which is necessary for the deposition of collagen, into cells
- Tensile strength and connective tissue production are significantly lower in diabetics
- Arterial occlusive disease can impair healing
- Reduced sensation may leave wounds undetected
- Patients with diabetes have more difficulty resisting infection and their wounds heal more slowly than non-diabetic patients

# Wound Dehydration

- Wound healing occurs more rapidly when dehydration is prevented
- Epidermal cells migrate faster and cover the wound surface sooner in a moist environment than under a scab

# Assessing Risk

- Number and type of medical diagnoses
- Presence of chronic health problems
- Chronologic age
- Immobility/ability to move independently
- Mental status/level of consciousness
- Nutritional status
- Incontinence
- Presence of infection
- Adequacy of circulation

# Risk Factors

- Immobility probably is the greatest threat for pressure ulceration
- Incontinence increases the risk for pressure ulceration because it causes excessively moist skin and chemical irritation
- Mental status impairment may limit ability for self-care
- Stress causes the adrenal glands to increase production of glucocorticoids, which inhibit collagen production, and thereby increase the risk of pressure ulceration

# Risk Assessment Scales

- The Norton Scale –
  - Rates physical condition, mental state, activity level, patient mobility, and incontinence on a scale of 1 to 4
  - Total scores range from 5 to 20-- the lower the score the higher the risk of ulceration
  - Is simple and easy to use, but does not include nutrition

# Risk Assessment Scales

- Braden Scale—The Braden Scale has six subscales divided into two categories
  - Intensity and duration of pressure: mobility, activity, and sensory perception
  - Tissue tolerance:  moisture, nutrition, and friction/shear

# Wound Healing

- Whenever possible, the body should be allowed to heal itself

- The best treatment is to support conditions that promote optimum healing—such as protection from trauma and maintaining a moist environment

# Evaluation of Healing

- Use a systematic and consistent method to record wound assessments

- Examination should include:
  - Measurement of the wound's length, width, and depth measured in centimeters or millimeters
  - Observation of inflammation, wound contraction, granulation, and epithelialization

# Skin Inspection

- Pressure interrupts blood flow and causes pallor
  - Pallor reflects tissue ischemia
  - Skin should quickly return to its normal color with relief from pressure as blood flow returns
- First External Sign of Ischemia—
  - The skin becomes reddened after the pressure is removed
  - Bright flush generally lasts from half to three-fourths the duration of ischemia
  - Vessels are dilated and the amount of blood available increases for nutrition, oxygenation and removal of waste products

# Skin Inspection

- Blanchable erythema—In light-skinned individuals
  - Compressing the reddened area causes the color to blanch or turn pale
  - Redness returns immediately after compression is relieved
  - Causes no long-term effect on the tissue; should return to its normal color within 24 hours
- In dark-skinned patients
  - Comparing skin on the contralateral side can help in assessment of subtle color changes
  - Palpate for increased warmth, a feeling of tightness, and areas of hardness under the skin

# Skin Inspection

Non-Blanchable Erythema—this may be the first outward sign of tissue destruction. As the tissues are deprived of oxygen beyond the critical period, cells die. Non-blanchable erythema is reversible if it is recognized early and treated.

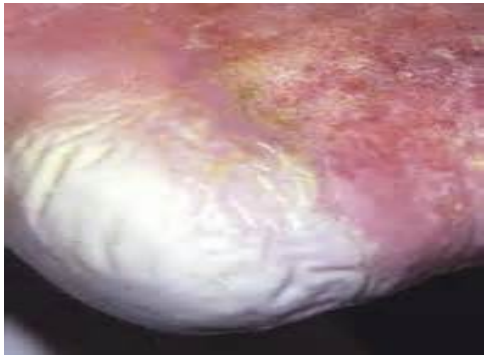
# Assessing the Ulcer

- Pressure ulcers range from non-blanchable erythema of intact skin to deep destruction and loss of tissue
- Induration may extend far beyond the open wound
- Inspection alone may not reveal the extent of the ulcer, which may have spread extensively beneath the skin, undermining along fascial planes

# Terms

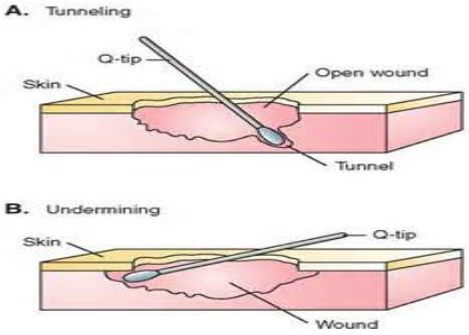
- Induration:  Tissue firmness that may occur around a wound margin


- Erythema:  An inflammatory redness of the skin due to engorged capillaries
- Maceration:  Softening of a tissue by soaking until the connective tissue fibers are so weakened that the tissue components can be teased apart



# Terms

- Undermining:  a tunneling effect or pocket occurring under the pressure ulcer edges or margins




- Slough:  Nonviable tissue is loosely attached and characterized by string-like, moist, necrotic debris; yellow, green, or gray in color

# Terms

- Eschar:  Nonviable (dead) wound tissue characterized by a leathery, black crust covering an underlying necrotic process
- Granulation:  Formation in wounds of soft, pink, fleshy projections consisting of new capillaries surrounded by fibrous collagen

# Assessment of the Pressure Ulcer

- History:  etiology, duration, prior treatment
- Anatomic location
- Stage
- Size:  length, width, and depth measured in centimeters
- Extent:  edges, sinus tracts, undermining, tunneling
- Exudate or drainage
- Necrotic tissue: slough and eschar
- Granulation tissue
- Epithelialization or new skin growth

# Manage Pressure

- Pressure management entails the awareness of proper body positioning, recognizing the importance of turning and repositioning , and choosing suitable support surfaces for sleeping and sitting

# Body Positioning

- In Bed
  - Do not position an individual on skin that is already reddened by pressure
  - Donut-shaped products reduce the blood flow to an even wider area of tissue
  - Pillow placement and bridging can help reduce pressure
  - Do not place an individual directly on the greater trochanter
  - Heels should be suspended to avoid pressure
  - The head of the bed should be raised as little as possible (no more than 30˚)

# Turning and Repositioning

- Healthy people change position as frequently as every 15 minutes
- Those unable to reposition themselves should be repositioned frequently enough to allow any reddened areas of skin to recover from pressure
- Repositioning should happen at least every 2 hours while in bed and at least every hour when in a wheelchair
- Never sit on personal items such as keys, pens, phone, etc.

# Turning and Repositioning

- Sitting carries the greatest risk for forming pressure ulcers
- To avoid effects of friction and shear forces
  - Lift rather than drag individuals across the bed surface
  - Have the individuals wear socks and long sleeves to protect heels and elbows

# Skin Care

- Massaging reddened areas of skin over bony prominences may reduce blood flow and cause tissue damage
- With older adults, gentle handling can reduce the likelihood of skin tears
- Advancing age is closely associated with skin dryness.  Central or room humidifiers can significantly reduce the detrimental effect of low humidity

# Cleansing the Skin

- Frequent bathing may remove the natural barrier and increase skin dryness
- The temperature of bath water should be slightly warm
- Use gentle washing with a soft cloth and patting the skin dry with a soft towel

# Moisturizing the Skin

- It is important to keep the skin well lubricated
- Topical agents relieve the signs and symptoms of dry skin
  - Lotions—highest water content, evaporate the most quickly and need to be reapplied the most frequently
  - Creams—preparations of oil in water; more occlusive than lotions; need to be applied about four times daily for maximum effectiveness.
  - Ointments—mixtures of water in oil, the most occlusive, and provide the longest lasting effect on skin moisture

# Protecting the Skin

- Skin that is waterlogged from constant wetness is more easily eroded by friction, more permeable to irritants, and more readily colonized by microorganisms than normal skin

- Urinary and fecal incontinence create problems from excessive moisture and chemical irritation

# Summary

- Healthy skin requires a holistic approach
- Pressure must be managed
- Routine skin inspection is a must
- If a pressure ulcer develops, one must first find the source and relieve the pressure
- Stage and manage any wound
- Use a team approach
- Monitor

Thank You

# Bibliography

Maklebust, JoAnn and Sieggreen, Mary. *Pressure Ulcers – Guidelines for Prevention and Management*. Springhouse, Pennsylvania, Sprighhouse Corporation, 2001. Print.

Demarco, Sharon. "Wound and Pressure Ulcer Management." Johns Hopkins Medicine. 11 March 2014.

Wilhelmy, Jennifer, RN, CWCN, CNP. "Save our Skin Heal our Holes: The basics of pressure ulcer prevention and wound care. DDNA National Conference 2014.