

Latest Updates on Staging Pressure Injuries

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Objectives

- Etiology of pressure injuries
 - Microclimate
- Overview of changes to NPUAP Pressure Injury Staging System
- Beyond staging

Why Revise Staging System?

Review
questions
NPUAP
receives
about
staging



New Understanding of Etiology

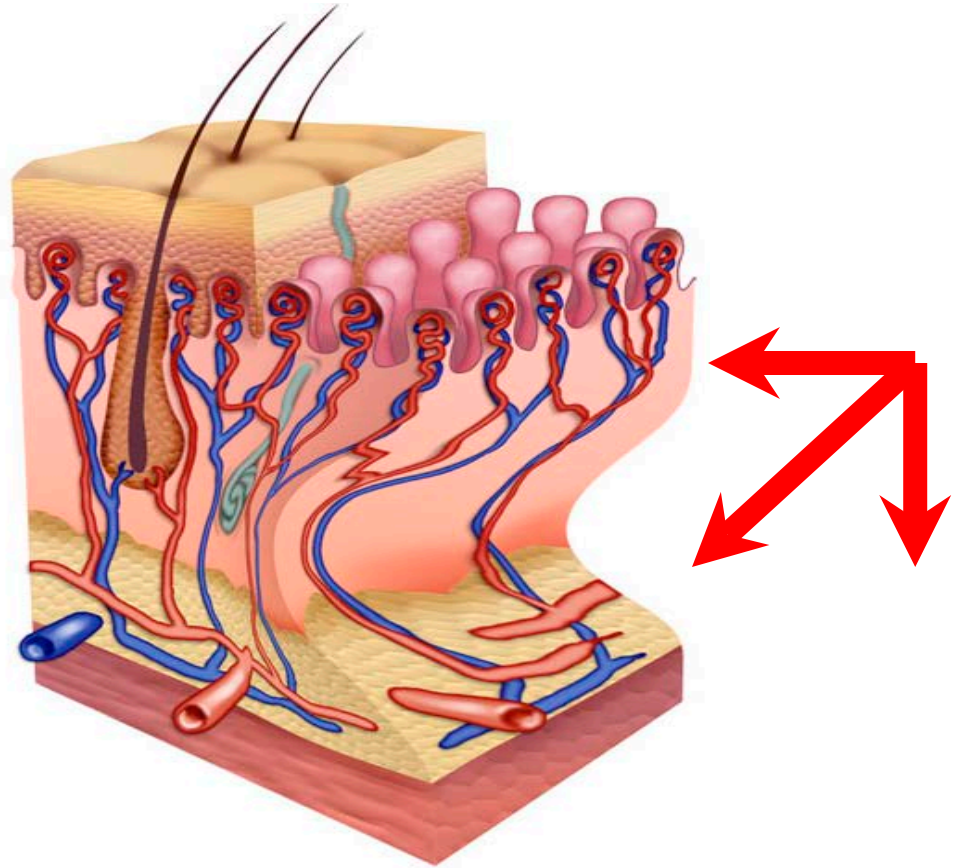
Global Guidelines

- Pressure
- Shear
- Microclimate
 - Temperature, humidity, airflow
- Tissue Tolerance
- Nutrition, Age, Mobility




Forces

- Pressure
- Shear
 - Resultant



Microclimate



Temperature,
humidity, and airflow
at patient/support
interface

Sources of Moisture

- Perspiration
- Drainage
- Incontinence

Role of Microclimate Moisture

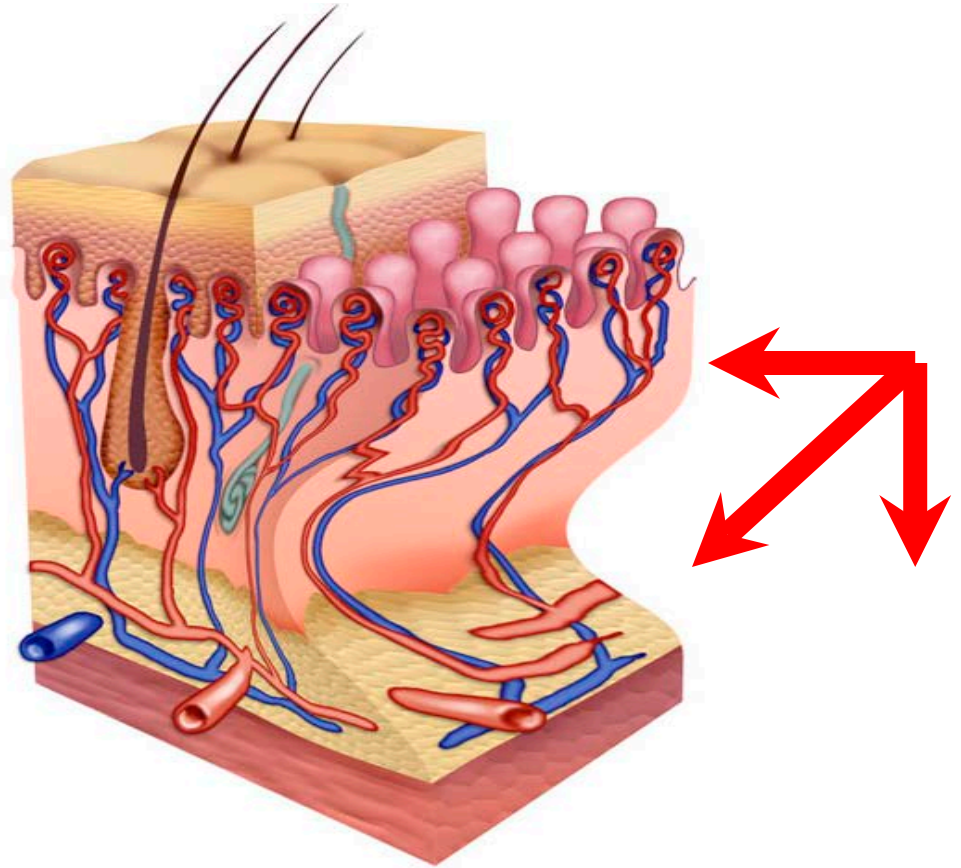
- Dry skin – brittle breaks
- Moisture increases friction and shear
- Skin tensile strength decreases
- Load distribution
 - Increased tissue deformation
 - Maceration

Role of Microclimate Temperature

- As temperature rises
 - Increased metabolic demand
 - Ischemia risk
 - Increased moisture
 - Tissue properties

Prior to Staging a Wound

- Clean the wound
- Determine etiology
 - Presence of pressure and/or shear



Ulcer to Injury

Pressure injuries present as both intact and open wounds



Ulcer

- A **break** in skin or mucous membrane with loss of surface tissue, disintegration and necrosis of epithelial tissue, and often pus

Injury Definition

Injury = Bodily damage caused by transfers of energy and also the absence of energy

- Drowning, asphyxia, hypothermia

Low energy exposure injuries

- Carpal tunnel
- Pressure injury

Pressure ~~Ulcer~~ Injury

- Ulcer does not accurately describe the physical presentation of Stage 1 or Deep Tissue Pressure Injuries
 - Can have an injury without an ulcer
 - Can not have an ulcer without an injury
- Overwhelming support for the term *injury*

FAQ: Injury and Potential Litigation

- Discussed in detail by NPUAP prior to the conference
- Plaintiff and defense attorneys were consulted
 - *Professionals need to develop the science; attorneys look at the facts in the case to determine if it was unavoidable.*
- The word "injury" occurs in other clinical diagnostic labels that may or may not be litigated
 - Acute kidney injury, spinal cord injury, traumatic brain injury

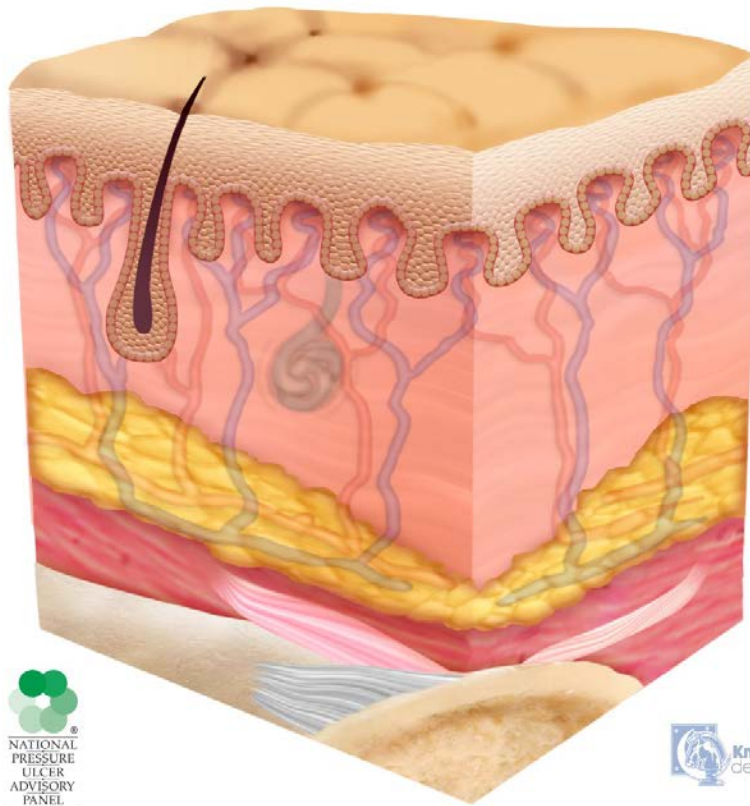
The National Law Review

January 2017

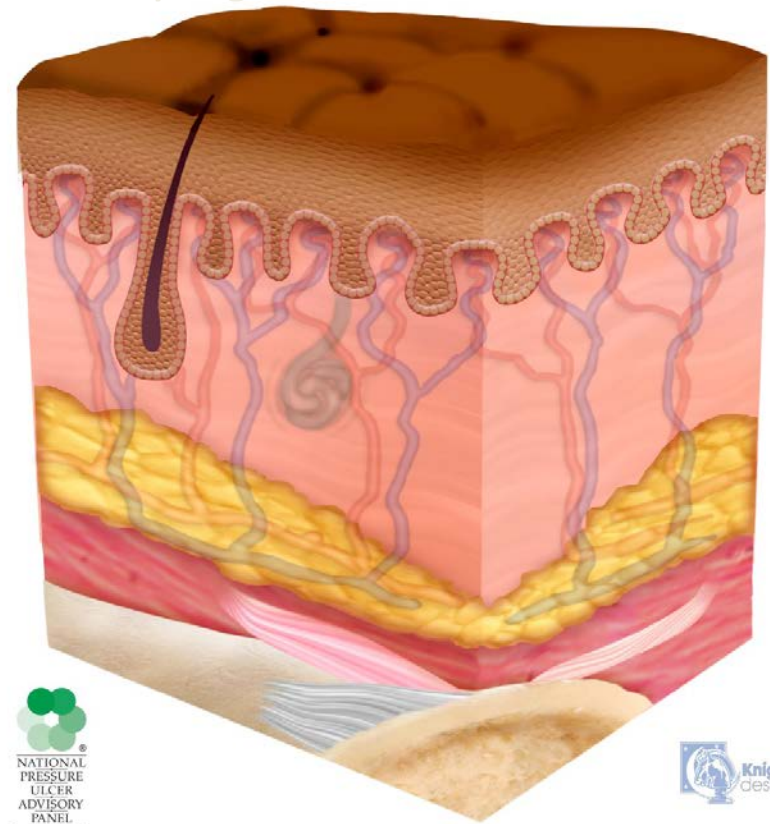
- Recommend providers of pressure injury treatment incorporate the new terminology and staging system into their diagnoses and treatment moving forward
- Integrate these changes into their patient charts and any facility specific wound documentation
- Proper wound classification contained within the patient's chart will permit a party to use the patient's treatment records as evidence of the severity of the patient's wounds over time
- This evidence coupled with documented proof of the administering of the recommended wound care treatment will permit any party to present a high-quality defense to any pressure injury lawsuits that may arise

New Artwork Healthy Skin

Lightly Pigmented



Darkly Pigmented



Old Pressure Ulcer Definition

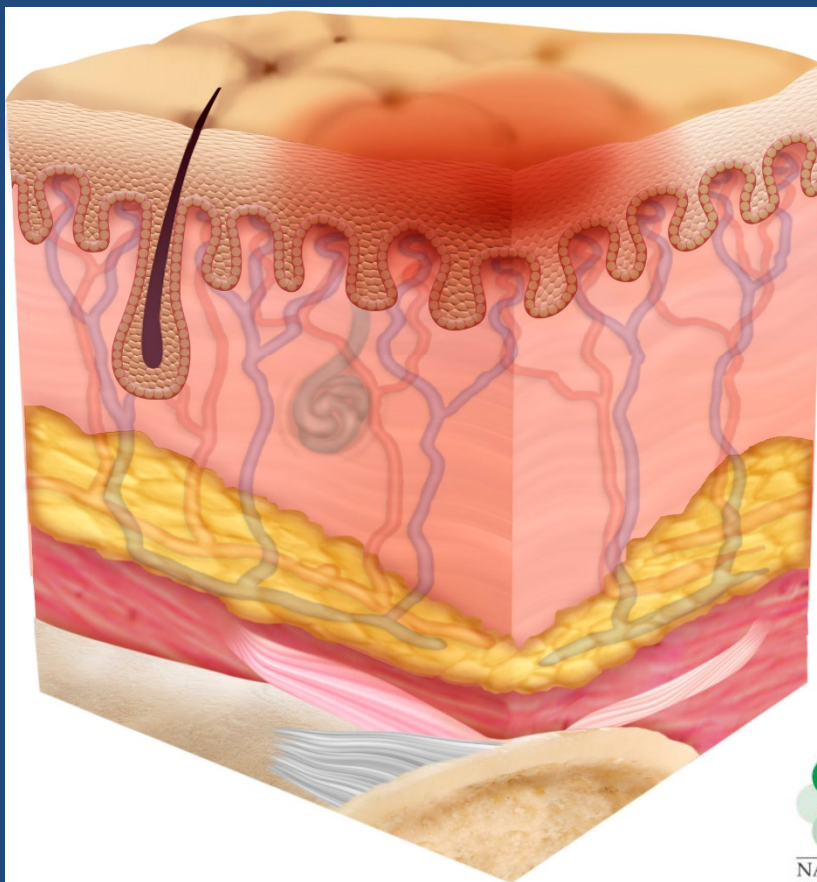
A pressure ulcer is localized injury to the skin and/or underlying tissue usually over a bony prominence, as a result of pressure, or pressure in combination with shear. A number of contributing or confounding factors are also associated with pressure ulcers; the significance of these factors is yet to be elucidated.

New Pressure Injury Definition

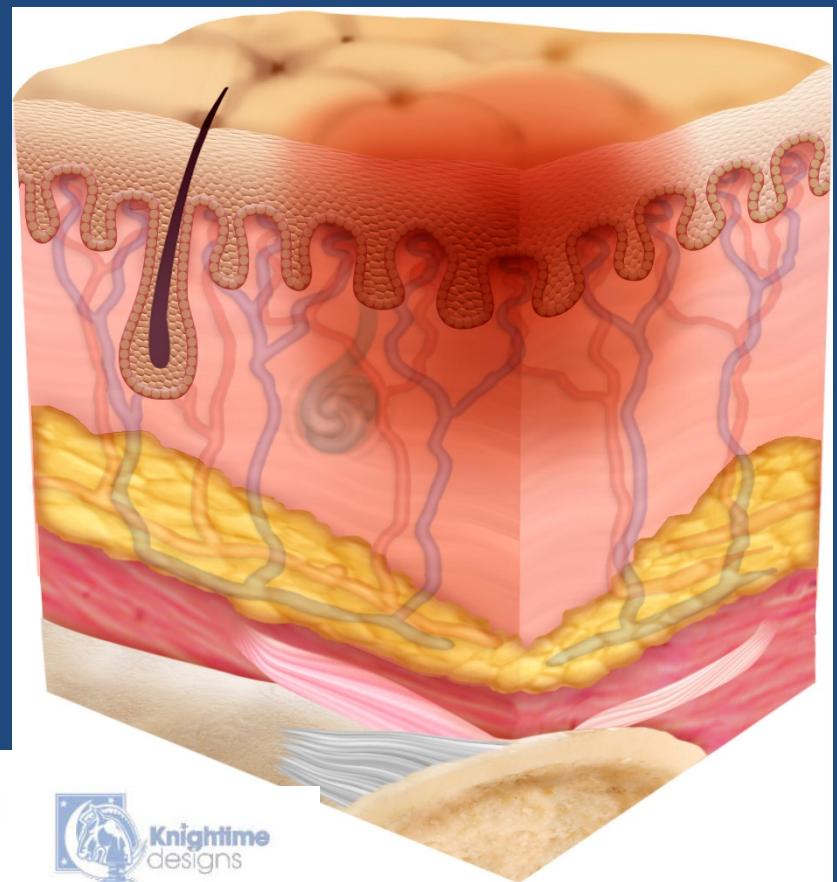
A pressure injury is localized damage to the skin **and** underlying soft tissue usually over a bony prominence or related to a **medical or other device**. The injury can present as **intact skin or an open ulcer** and may be painful. The injury occurs as a **result of** intense and/or prolonged **pressure or pressure in combination with shear**. The tolerance of soft tissue for pressure and shear may also be affected by microclimate, nutrition, perfusion, comorbidities and condition of the soft tissue.

Stage 1 Pressure Injury: Erythema

Blanchable



Non-Blanchable



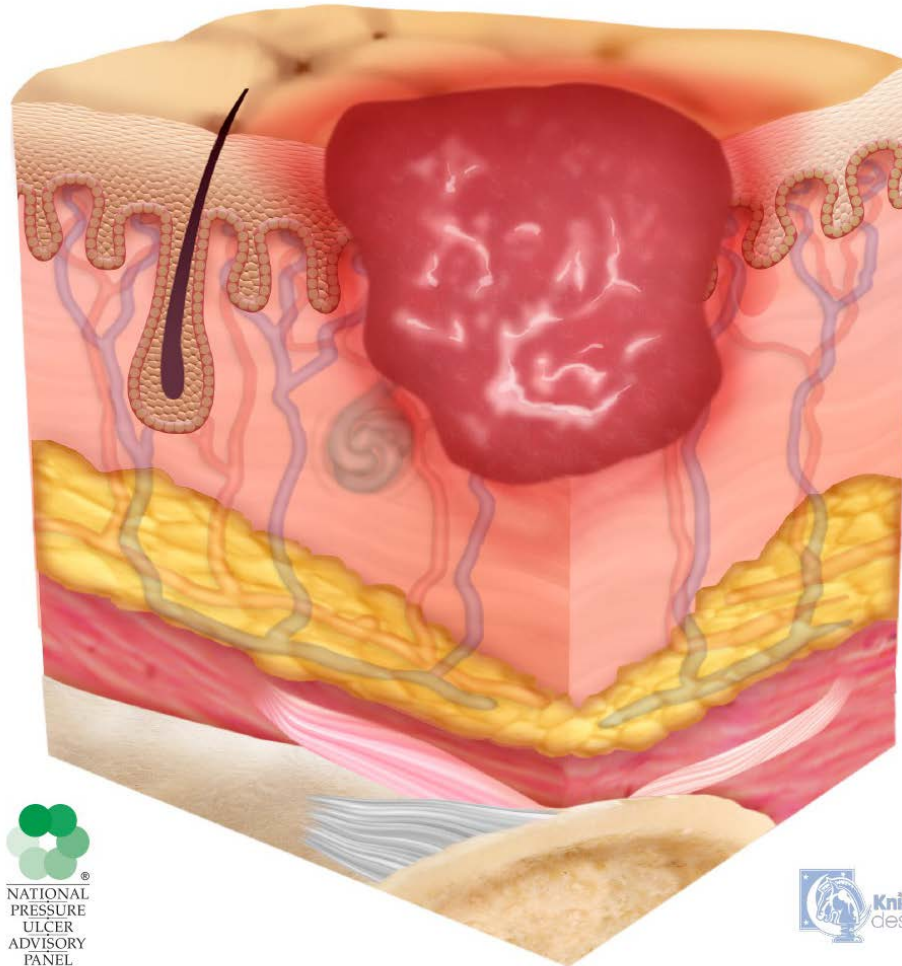
**Old Stage I Pressure Ulcer Definition:
Non-blanchable erythema**

Intact skin with non-blanchable redness of a localized area usually over a bony prominence. Darkly pigmented skin may not have visible blanching; its color may differ from the surrounding area. The area may be painful, firm, soft, warmer or cooler as compared to adjacent tissue. Stage I may be difficult to detect in individuals with dark skin tones. May indicate “at risk” persons.

**Stage 1 Pressure Injury:
Non-blanchable erythema
of intact skin**

Intact skin with a localized area of non-blanchable erythema, which may appear differently in darkly pigmented skin. Presence of blanchable erythema or changes in sensation, temperature, or firmness may precede visual changes. Color changes do not include purple or maroon discoloration; these may indicate deep tissue pressure injury.

Stage 2 Pressure Injury



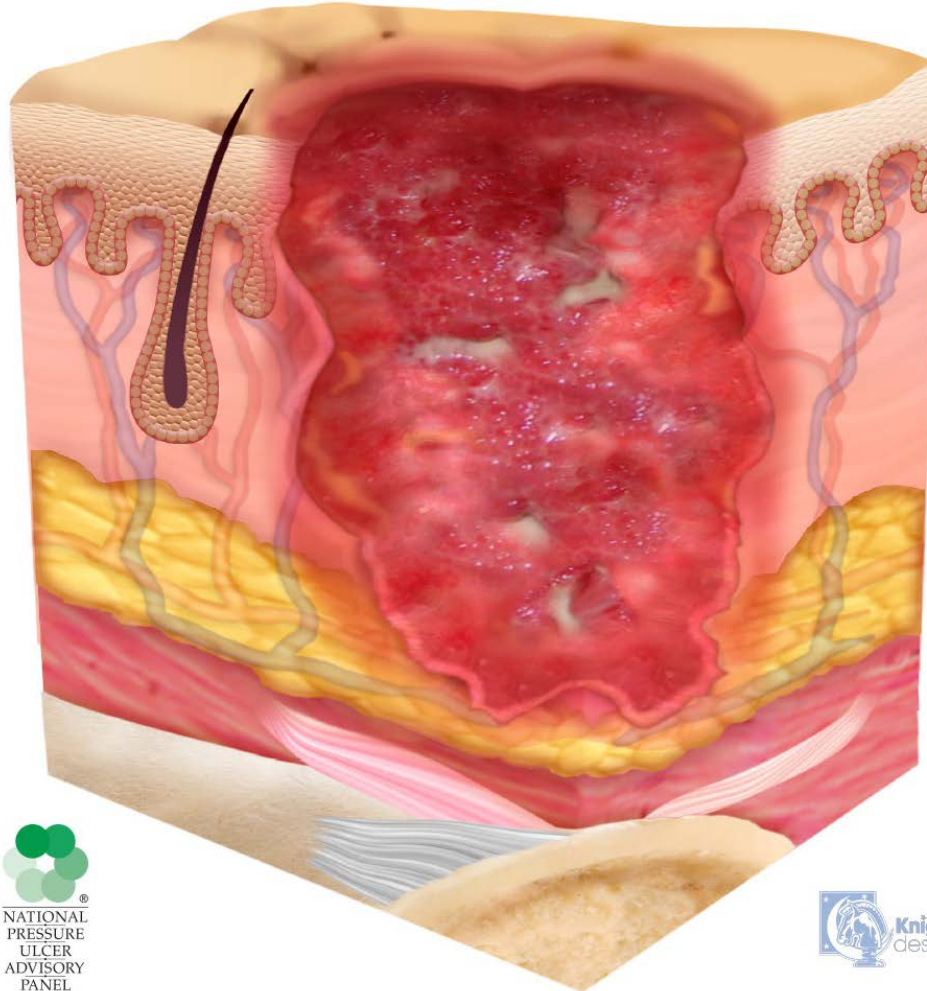
Old Stage II Pressure Ulcer Definition

- Partial thickness loss of dermis presenting as a shallow open ulcer with a red pink wound bed, without slough. May also present as an intact or open/ruptured serum-filled or sero-sanguineous filled blister. Presents as a shiny or dry shallow ulcer without slough or bruising*. This category should not be used to describe skin tears, tape burns, incontinence associated dermatitis, maceration or excoriation.
- *Bruising indicates deep tissue injury.

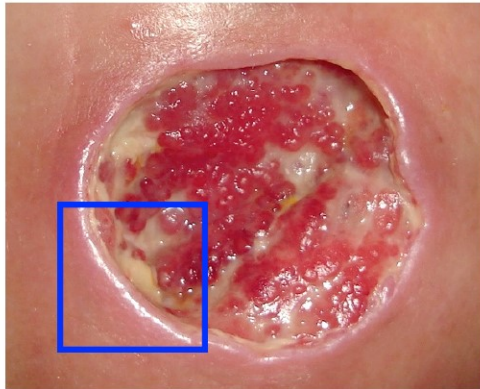
Stage 2 Pressure Injury: Partial-thickness skin loss with exposed dermis

Partial-thickness loss of skin with exposed dermis. The wound bed is viable, pink or red, moist, and may also present as an intact or ruptured serum-filled blister. Adipose (fat) is not visible and deeper tissues are not visible. Granulation tissue, slough and eschar are not present. These injuries commonly result from adverse microclimate and shear in the skin over the pelvis and shear in the heel. This stage should not be used to describe moisture associated skin damage (MASD) including incontinence associated dermatitis (IAD), intertriginous dermatitis (ITD), medical adhesive related skin injury (MARSI), or traumatic wounds (skin tears, burns, abrasions).

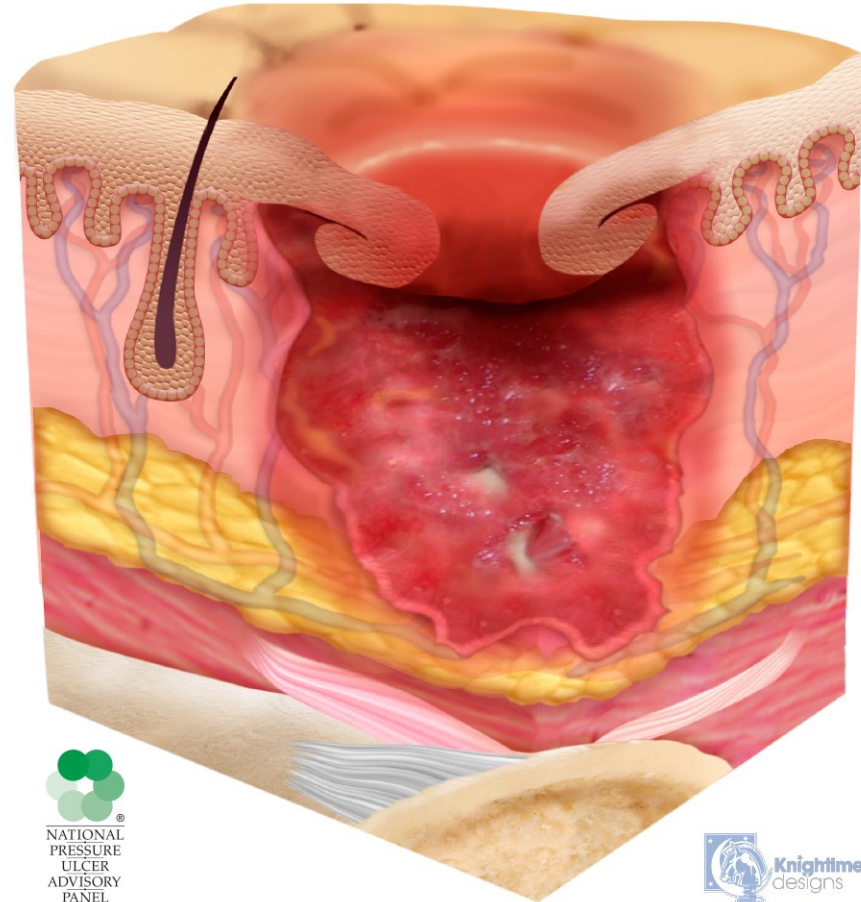
Stage 3 Pressure Injury



Stage 3 Pressure Injury with Epibole



Area of Focus



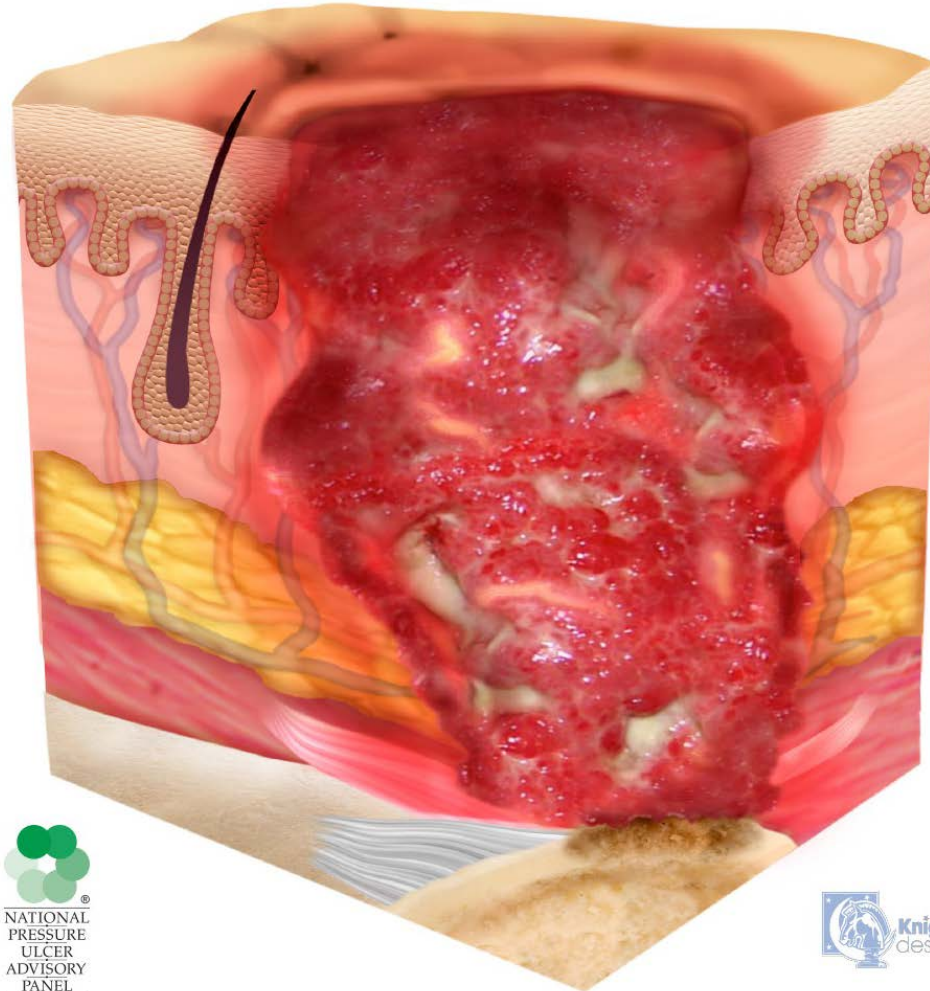
Old Stage III Pressure Ulcer: Full thickness skin loss

Full thickness tissue loss. Subcutaneous fat may be visible but bone, tendon or muscle are *not* exposed. Slough may be present but does not obscure the depth of tissue loss. *May* include undermining and tunneling. The depth of a Category/Stage III pressure ulcer varies by anatomical location. The bridge of the nose, ear, occiput and malleolus do not have (adipose) subcutaneous tissue and Category/Stage III ulcers can be shallow. In contrast, areas of significant adiposity can develop extremely deep Category/Stage III pressure ulcers. Bone/tendon is not visible or directly palpable.

Stage 3 Pressure Injury: Full-thickness skin loss

Full-thickness loss of skin, in which adipose (fat) is visible in the ulcer and granulation tissue and epibole (rolled wound edges) are often present. Slough and/or eschar may be visible. The depth of tissue damage varies by anatomical location; areas of significant adiposity can develop deep wounds. **Undermining and tunneling may occur. Fascia, muscle, tendon, ligament, cartilage and/or bone are not exposed. If slough or eschar obscures the extent of tissue loss this is an Unstageable Pressure Injury.**

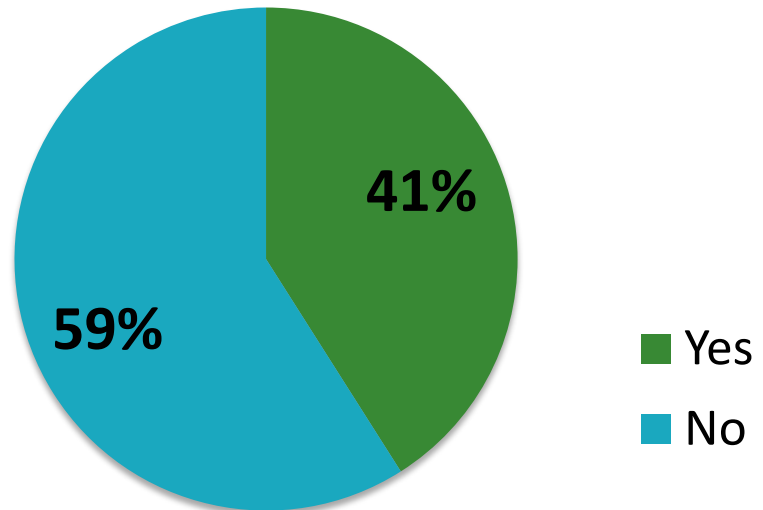
Stage 4 Pressure Injury



Remove the term osteomyelitis
from the definition of a Stage 4.

Yes = 41%

No = 59%



Discussion

- Helps non-experts remember osteomyelitis is a possibility
- Complication not part of definition
- Need to raise awareness so keep in
- Cut so that we don't throw antibiotics at it without diagnosis
- Leave out – other complications, cellulitis, infected joint space not mentioned

Old Stage IV Pressure Ulcer:

Full thickness skin loss

Full thickness tissue loss with exposed bone, tendon or muscle. Slough or eschar may be present. Often includes undermining and tunneling. The depth of a Category/Stage IV pressure ulcer varies by anatomical location. The bridge of the nose, ear, occiput and malleolus do not have (adipose) subcutaneous tissue and these ulcers can be shallow. Category/Stage IV ulcers can extend into muscle and/or supporting structures (e.g., fascia, tendon or joint capsule) making osteomyelitis or osteitis likely to occur. Exposed bone/muscle is visible or directly palpable.

Stage 4 Pressure Injury: Full-thickness skin and tissue loss

Full-thickness skin and tissue loss with exposed or directly palpable fascia, muscle, tendon, ligament, cartilage or bone in the ulcer. Slough and/or eschar may be visible. Epibole (rolled edges), undermining and/or tunneling often occur. Depth varies by anatomical location. If slough or eschar obscures the extent of tissue loss this is an Unstageable Pressure Injury.

Stage 3 Pressure Injury:

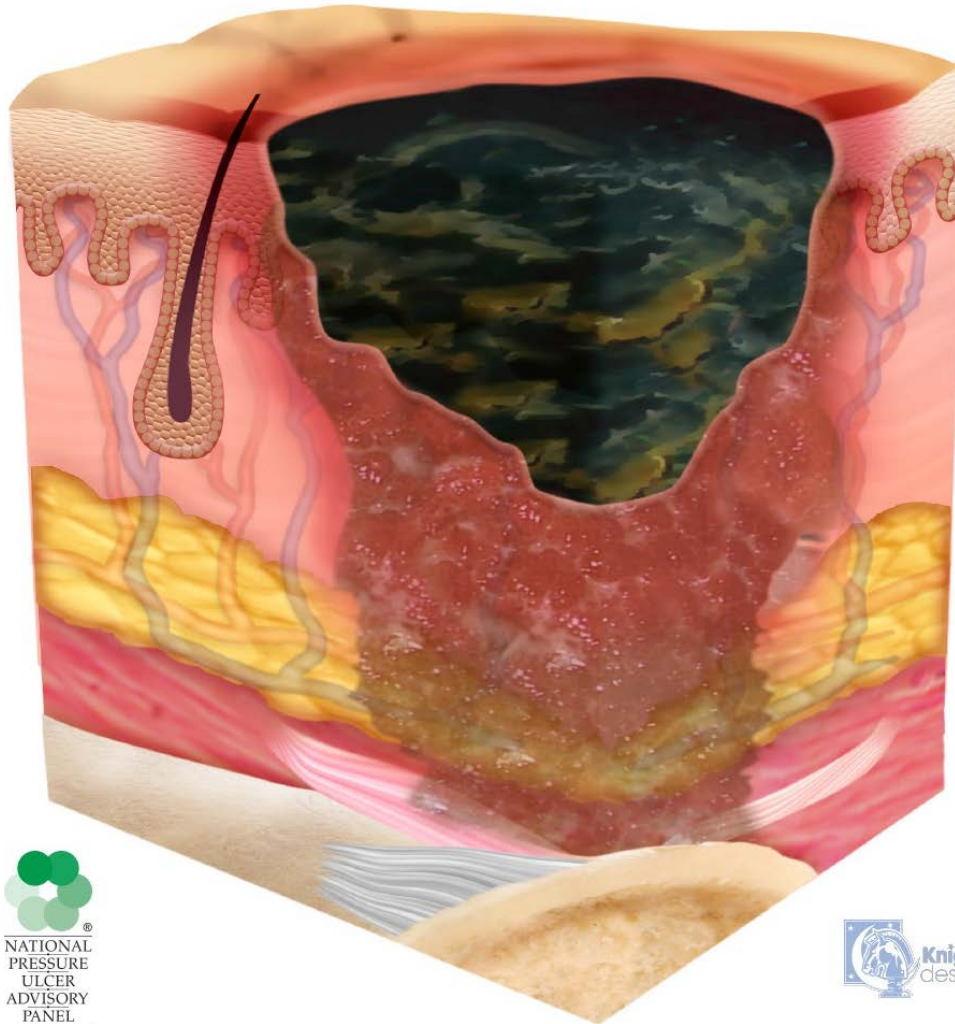
Full-thickness skin loss

Full-thickness loss of skin, in which adipose (fat) is visible in the ulcer and granulation tissue and epibole (rolled wound edges) are often present. Slough and/or eschar may be visible. The depth of tissue damage varies by anatomical location; areas of significant adiposity can develop deep wounds. Undermining and tunneling may occur. Fascia, muscle, tendon, ligament, cartilage and/or bone are not exposed. If slough or eschar obscures the extent of tissue loss this is an Unstageable Pressure Injury.

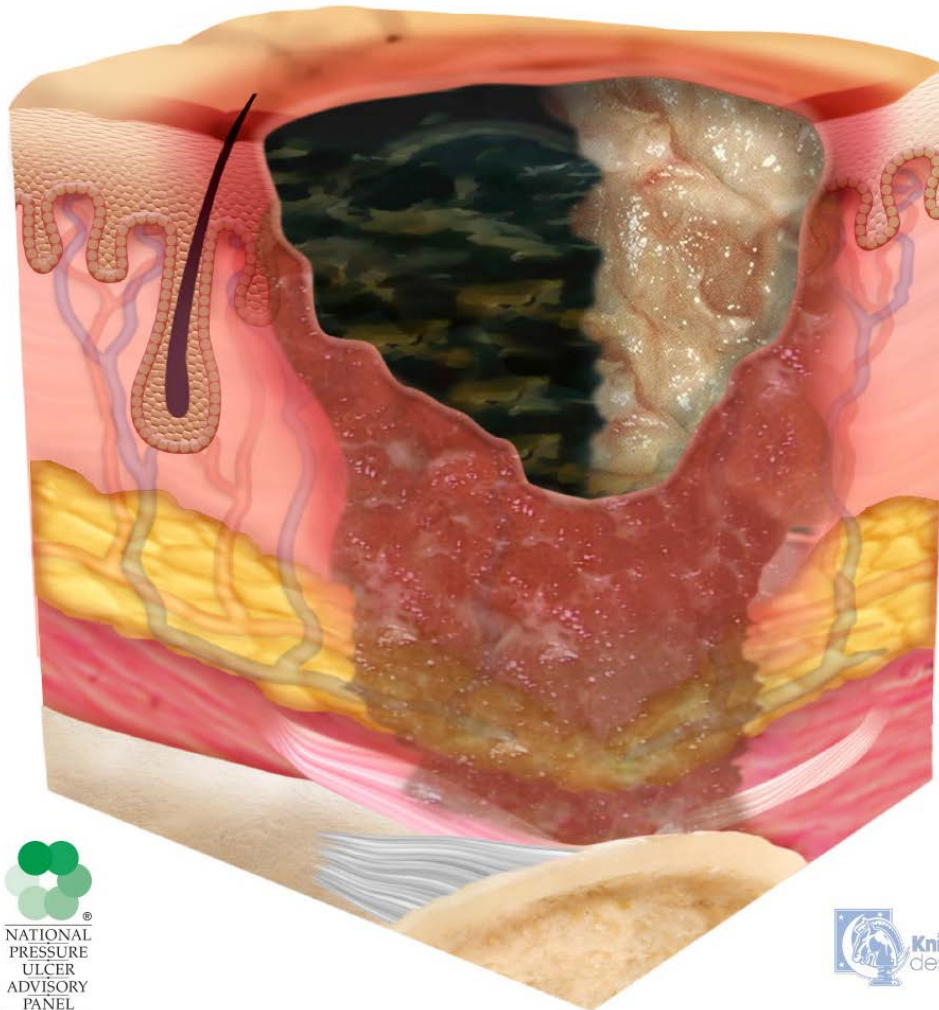
Stage 4 Pressure Injury: Full-thickness skin and tissue loss

Full-thickness skin and tissue loss with exposed or directly palpable fascia, muscle, tendon, ligament, cartilage or bone in the ulcer. Slough and/or eschar may be visible. Epibole (rolled edges), undermining and/or tunneling often occur. Depth varies by anatomical location. If slough or eschar obscures the extent of tissue loss this is an Unstageable Pressure Injury.

Unstageable Dark Eschar



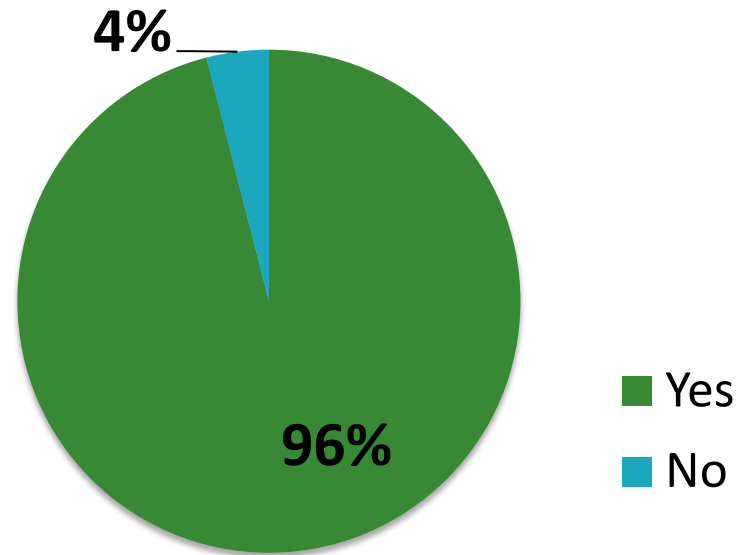
Unstageable Focus on Slough



Change “depth” to “extent” in Unstageable.

Yes = 96%

No = 4%



**Old Unstageable Pressure Ulcer:
Full thickness skin or tissue loss –
depth unknown**

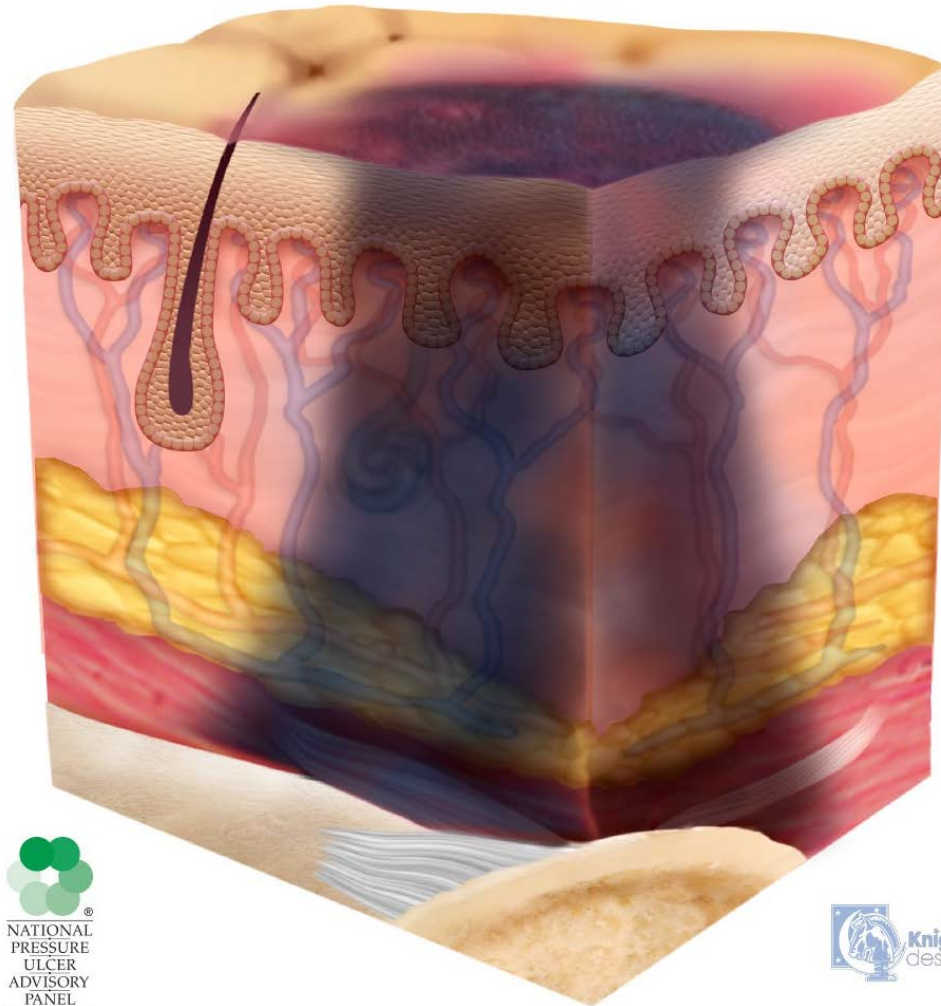
Full thickness tissue loss in which actual depth of the ulcer is completely obscured by slough (yellow, tan, gray, green or brown) and/or eschar (tan, brown or black) in the wound bed. Until enough slough and/or eschar are removed to expose the base of the wound, the true depth cannot be determined; but it will be either a Category/Stage III or IV. Stable (dry, adherent, intact without erythema or fluctuance) eschar on the heels serves as “the body’s natural (biological) cover” and should not be removed.

Unstageable Full-Thickness Pressure Injury: Obscured Full-thickness skin and tissue loss

Unstageable Pressure Injury: Obscured full-thickness skin and tissue loss

Full-thickness skin and tissue loss in which the extent of tissue damage within the ulcer cannot be confirmed because it is obscured by slough or eschar. If slough or eschar is removed, a Stage 3 or Stage 4 pressure injury will be revealed. Stable eschar (i.e. dry, adherent, intact without erythema or fluctuance) on an ischemic limb or the heel(s) should not be softened or removed.

Deep Tissue Pressure Injury (DTPI)



FAQ *Suspected*

- Original DTPI definition was written over 10 years ago
- Little was known about DTPI at that time
- Today we are able to diagnose with more accuracy.
- Can add the word “suspected” to the documentation about any definition or condition.
 - Suspected pressure injury or a suspected Stage 2 pressure injury.

Old Suspected Deep Tissue Injury: Depth Unknown

- Purple or maroon localized area of discolored intact skin or blood-filled blister due to damage of underlying soft tissue from pressure and/or shear. The area may be preceded by tissue that is painful, firm, mushy, boggy, warmer or cooler as compared to adjacent tissue.
- Deep tissue injury may be difficult to detect in individuals with dark skin tones.
- Evolution may include a thin blister over a dark wound bed. The wound may further evolve and become covered by thin eschar.
- Evolution may be rapid exposing additional layers of tissue even with optimal treatment.

Deep Tissue Pressure Injury: Persistent non-blanchable deep red, maroon or purple discoloration

Intact or non-intact skin with localized area of persistent non-blanchable deep red, **maroon, purple** discoloration or epidermal separation revealing a dark wound bed or **blood filled blister**. Pain and temperature change often precede skin color changes. Discoloration may appear differently in darkly pigmented skin. This injury results from intense and/or prolonged **pressure and shear forces** at the bone-muscle interface. The wound may evolve rapidly to reveal the actual extent of tissue injury, or may resolve without tissue loss. If necrotic tissue, subcutaneous tissue, granulation tissue, fascia, muscle or other underlying structures are visible, this indicates a full thickness pressure injury (Unstageable, Stage 3 or Stage 4). Do not use DTPI to describe vascular, traumatic, neuropathic, or dermatologic conditions.

DTPI Teaching Points

- **Confirm purple skin (appearing as ecchymoses or bruising) is due to pressure or shear and not medication or trauma**
- **Attempt to identify the timing and setting of the pressure/shear that lead to DTPI for root cause analysis**
- **Document the evolution of the DTPI following discovery**
 - **Sloughing of epidermis to reveal deeper tissue damage**
 - **If injury become full thickness, the Stage of the resultant injury**

Other Definitions

Old Medical Device Related Pressure Ulcer:

Medical device related pressure ulcers are pressure ulcers that result from the use of devices designed and applied for diagnostic or therapeutic purposes. The resultant pressure ulcer generally closely conforms to the pattern or shape of the device.

Medical Device Related Pressure Injury:

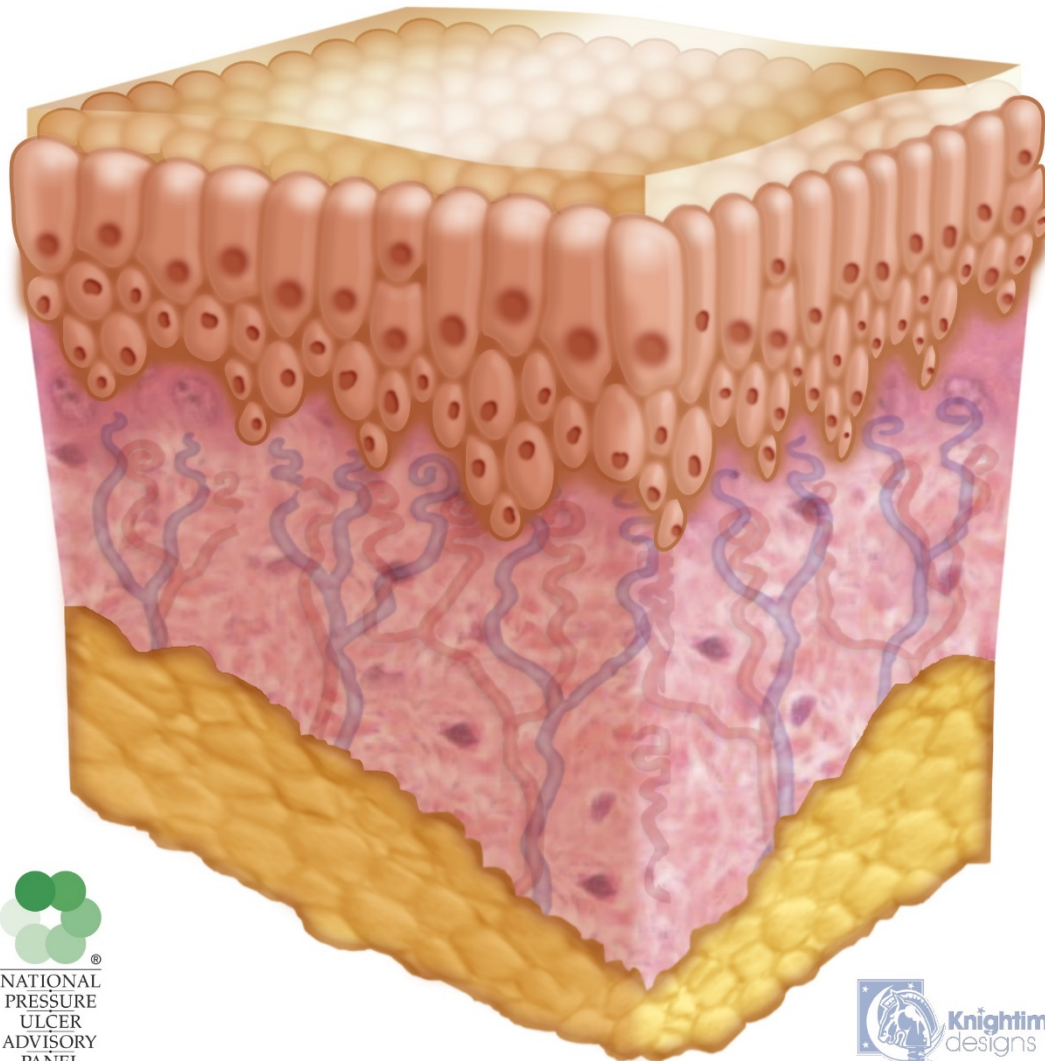
This describes an etiology. Medical device related pressure injuries result from the use of devices designed and applied for diagnostic or therapeutic purposes. The resultant pressure injury generally conforms to the pattern or shape of the device. The injury should be staged using the staging system.

Frequently Asked Question

When a pressure injury forms on the skin beneath a medical device, how is this injury to be identified?

- Stage x pressure injury on (named body part) from medical device

Mucosal Tissues



Mucosal Tissues

- Vulnerable to pressure from medical devices
 - Oxygen tubing, endotracheal tubes, bite blocks, urinary catheters, etc
- Scar tissue of the mucosa is remodeled and most injuries heal without scar formation.

Old Mucosal Pressure Ulcer

Mucosal Pressure Ulcers are pressure ulcers found on mucous membranes with a history of a medical device in use at the location of the ulcer.

Mucosal Membrane Pressure Injury:

Mucosal membrane pressure injury is found on mucous membranes with a history of a medical device in use at the location of the injury. Due to the anatomy of the tissue these injuries cannot be staged.

Quick Quiz

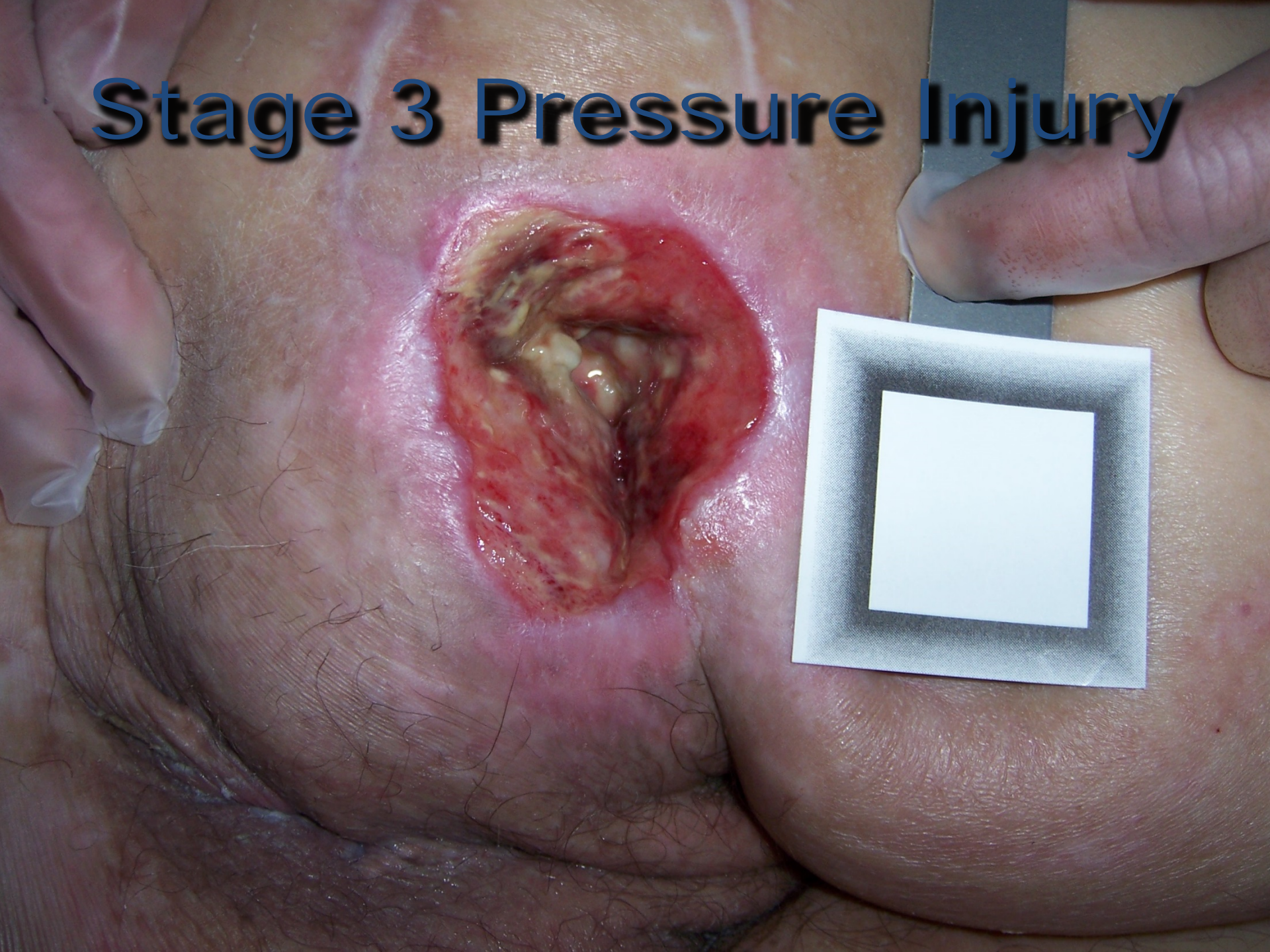
Stage 1 Pressure Injury



NOT a DTPI
Cocaine/Levamisole
- Cutaneous
vasoconstriction



Stage 3 Pressure Injury



Deep Tissue Pressure Injury





What is the Role of Staging?

- Clinical Purpose
- Research Value
- Alternatives



How Do We Relate This Information?

- Chart/Record
- Bedside communication among care providers



Progression Myths

- I-IV
- 1-4
- A-D

- Tissue Visible
- Depth = linear measurement

Staging is Not Unique to Pressure Injuries

- Cancer is staged
- Describes the severity of an individual's cancer based on the magnitude of the primary tumor as well as on the extent cancer has spread in the body
- Understanding the stage of the cancer helps doctors to develop a prognosis and design a treatment plan for individual patients

Acute Kidney Injury

- Formerly acute renal failure
- Staging system –
- RIFLE Class
 - risk, injury, failure
- AKIN Stage
 - 1,2,3

Spinal Cord Injury

- International standards for neurological classification of spinal cord injury
- Clinician-administered scale used to classify the severity (completeness) of injury in individuals with SCI.

—*American Spinal Injury Association*

Staging and Progression

- Stage for clarification and treatment
- Is prevention part of staging?
- Stop progression?
- “Heralding Sign”

Clinically – Staging is Not the End

- Staging is the start
- Stage and now what?
- CMS – Call to action
- Action item based on staging
- What will we do – treat / prevent / study?

Staging for Research

- Why stage?
- Apples to oranges?

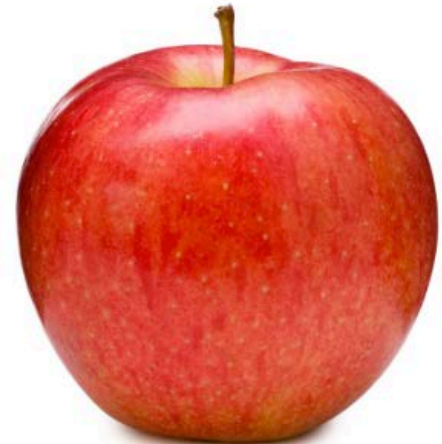


Precision

- How will we compare treatments?
- Efficacy?
- All pressure injuries are the same?
 - If all have same level of injury how do we compare?

Apples to Apples

- Without some way to describe pressure injuries that is universally agreed upon – how do we assess studies?



Basis of NPUAP Staging System

- Visual and directly palpable staging system
- Histopathology and Ultrasound Studies
- Other ways to stage?

If Not Visual Staging System – Then What?

- How do we assess what is in the wound bed or beneath the skin?



Before vs. After

Can we evaluate and predict in intact skin or wound bed?



Potential Predictors Wound Development

- Oxygen
- Temperature
- Sweat
- Urine
- Blood
- Microstructure

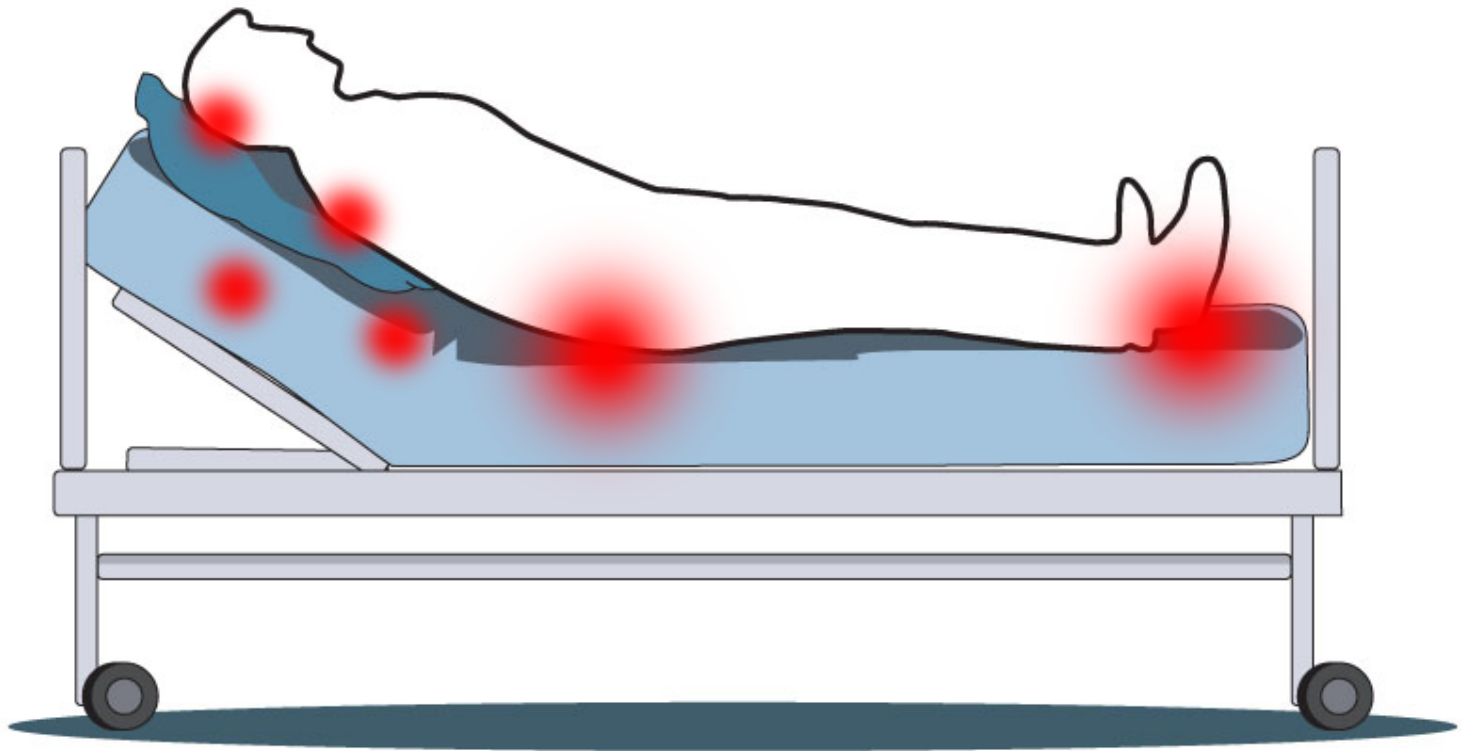
Non-Invasive Tissue Analysis

- Tissue Impedance
- Ultrasound
- Laser Doppler
- MRI
- Others

What and When Do We Evaluate?

- Does timing matter?
- Does location matter?
- Does cost matter?

Tissue Loading and Location



Fluids

- Urine
- Sweat
- Blood/Plasma/Serum
- Wound fluid

Urine

- Skin collagen metabolism SCI
 - Urinary excretion of Metabolite glucosyl-galactosyl hydroxylysine (glu-gal Hyl)
- Sustained increases in excretion
 - 2 months and as much as 5 months in advance of ulcer development
- Increased excretion of glu-gal Hyl associated ($p < 0.05$) with the development of a pressure ulcer

—Rodriguez & Claus-Walker 1988 Paraplegia

—Rodriguez G & Garber S 1994 Paraplegia

Sweat

- Easy specimen collection
- Non-invasive
- Stable marker
- Simple analysis
- Good Sensitivity and Specificity

Skin Biomarkers

- Sebutape – tape adsorption method
- Diaper, chemical or heat treated
- Measured targets (ELISA) released from the epidermis: IL-1a, IL-1RA, IL-8, TNF-a, MCP-1, GRO-a

—Perkins MA et al. *Skin Res Technol* 2001



Sweat Experiment

- Sensor applied pressure and measured TCpO₂ and TCpCO₂
- Sweat – lactate and urea measured
- Loaded and unloaded tissue
 - Increases in concentrations of both sweat lactate and urea at the loaded site compared with the unloaded
 - Loaded threshold value TCpO₂
- Establishing predictive indicators for the status of loaded soft tissues

—Knight SL Bader DL et al. *J Appl Physiol* (1985)

Sweatier Still

- In the reperfusion phase
 - Some of these metabolites returned to unloaded levels
- Proposed that specific metabolites may be used as an indicator of soft tissue damage

—Polliack A *J Rehabil Res Dev*1993

Sub-Epidermal Moisture (SEM)

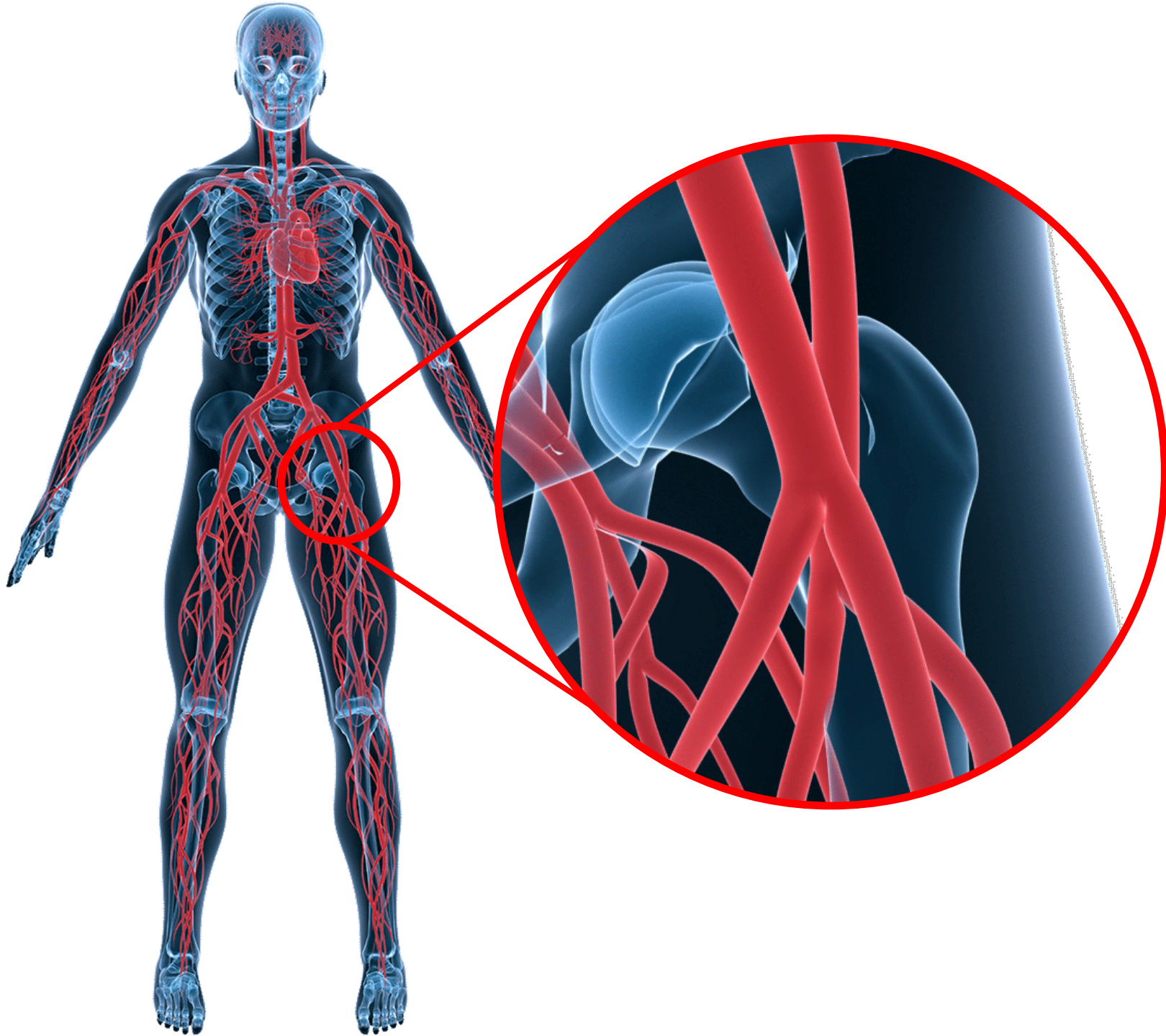
- Possible relationship between SEM and skin damage
- Greatest SEM with erythema
- SEM differed with anatomical location
 - Sacrum vs. Buttocks
- Need more data
- Clinical trial enrolling
 - <http://www.todayswoundclinic.com/news/enrollment-clinical-trial-early-detection-pressure-ulcers-opened>

Plasma

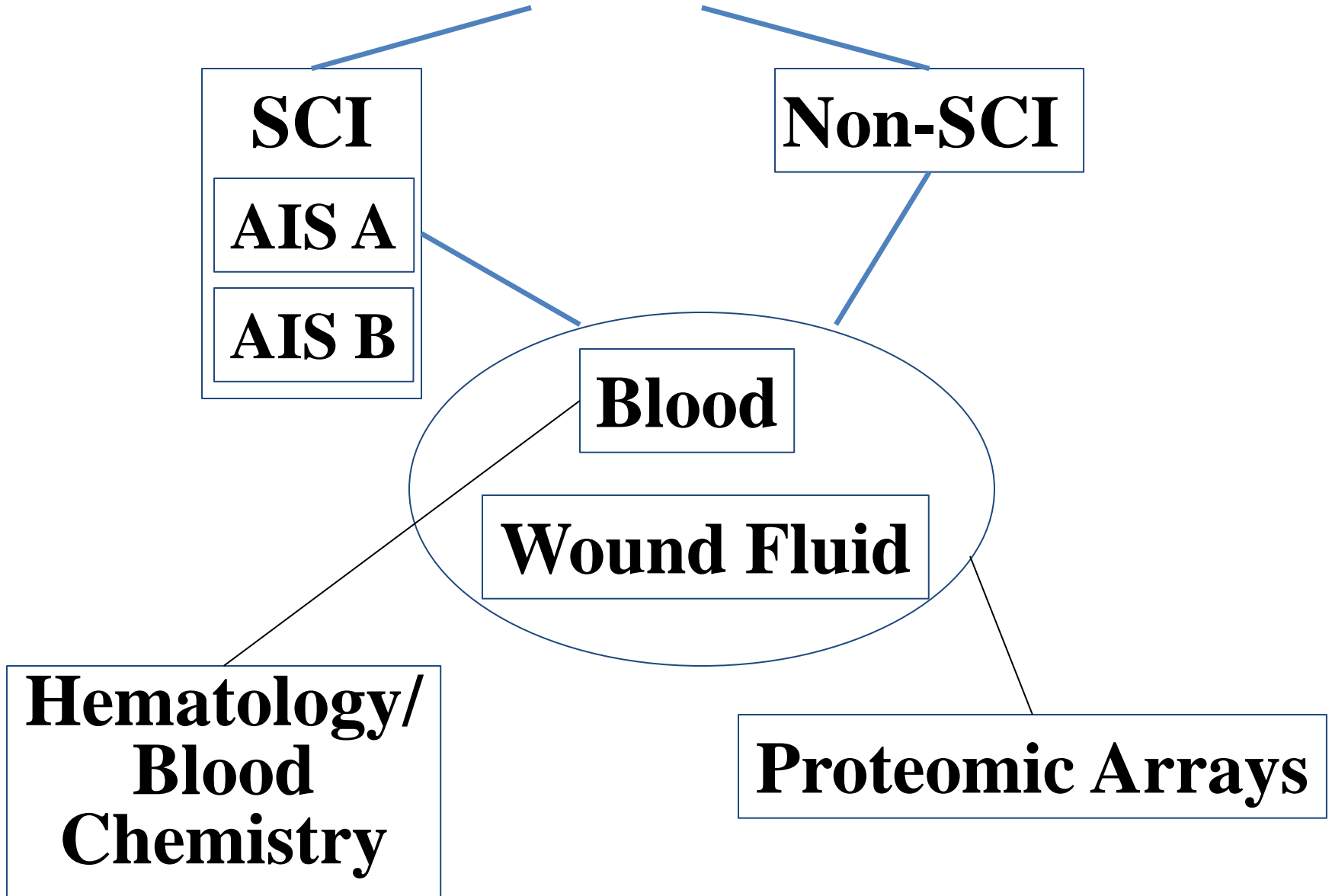
- Plasma variations of biomarkers for muscle damage
 - Male able-bodied and SCI subjects
- Measured creatine kinase (CK), myoglobin (Mb), heart fatty acid binding protein (H-FABP), C-reactive protein (CRP)
- CRP greatest in SCI and greatest in SCI with Pressure injury
- Further studied in Rat model
 - Mb elevated with compression

Systemic (Serum) vs. Wound Bed Fluid

- Compared the proteomic profile of the wound bed of pressure injuries in people *with* and *without* spinal cord injuries
- Evaluated levels of analytes in serum versus wound bed fluid



Chronic Pressure Injuries



Do Circulating Systemic Values
Translate to Wound Bed Values?

Not in this Study

Impedance Spectroscopy

- Impedance = Opposition to current
- Flexible and stretchable electronic device
 - multiplexed electrode array
- Non-invasive ‘smart bandage’ for early diagnosis
- Map pressure-induced tissue changes

Impedance Spectroscopy

- Rat model
 - Magnet induced damage
 - 1 or 3 hour
- Ischemic event
- Reactive hyperemia
- Tracked for 3 days post injury

—SL Swisher et al. *Nature Communications* 2015

Impedance Spectroscopy

- Detected early damage
 - Impedance correlated with tissue health
- Tissue Tolerance relationship to impedance?
- Location
 - Specific sites
 - Full body
- Cost
- Validity

SL Swisher et al. Nature Communications 2015

Non-Invasive Tissue Imaging

- Temperature/Infrared
- Ultrasound
- Laser Doppler
- MRI
- Others

Thermography

- Long-wave infrared thermography
- Comparing visual assessment to thermal overlay
- Relative temperature differential
- Potential predictive data/DTPI

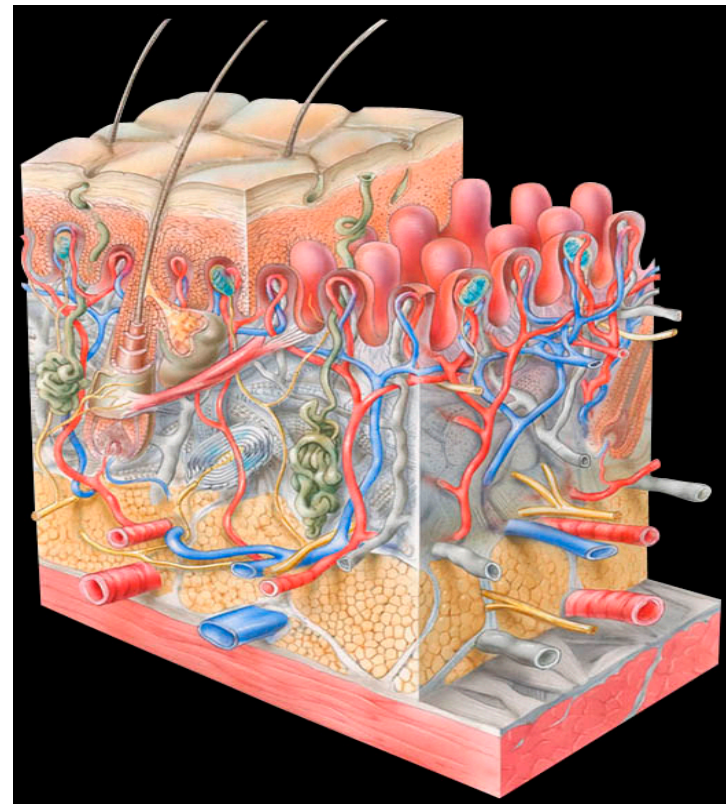
—Langemo D. and Spahn J. *Advances in Skin & Wound Care* April 2016, March 2017

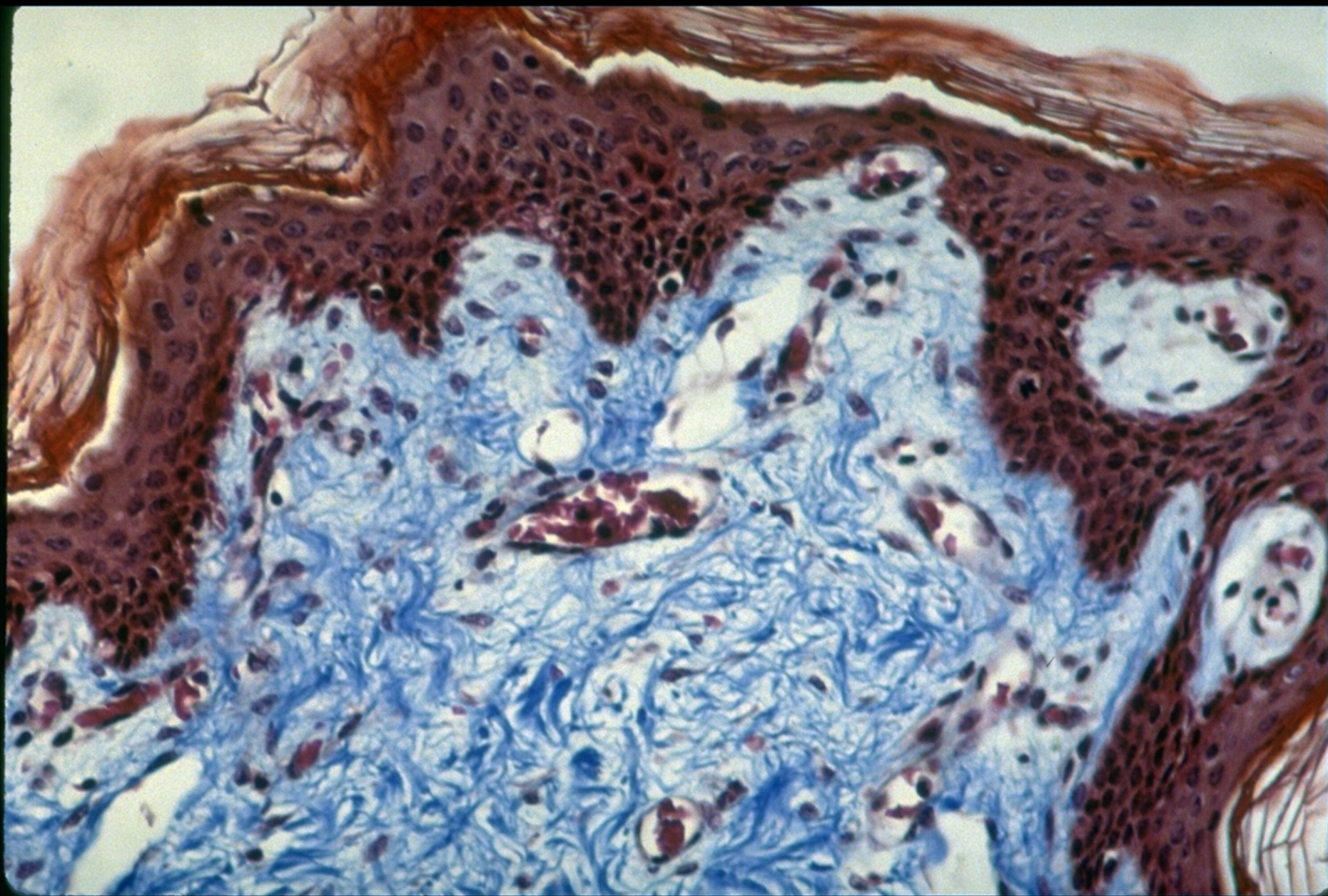
Tissue Visibility

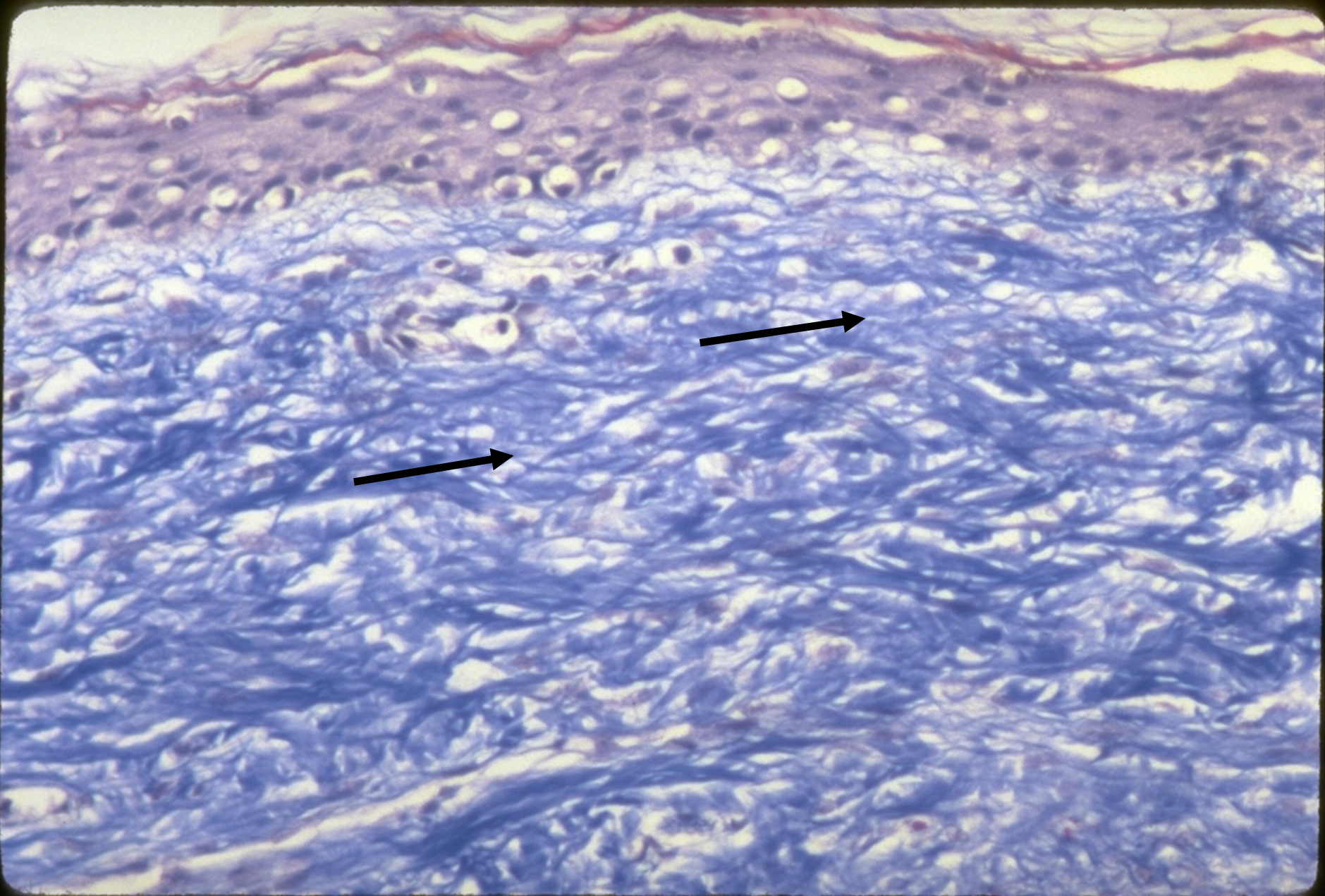
- What are we looking for?
- EARLY
Microstructural
changes

Histologic Sections

- Epidermis
- Dermis
- Subcutaneous
- Muscle







Collagen

- Major mechanical fiber in skin
- Alignment
- Dimensions

Collagen Remodeling

- Response to forces
 - Normal
 - Pathologic Condition
 - Wound Healing



Tissue Imaging

- Does the imaging match the histology?
- What are we looking for or at?

- Depth of injury?
- Dermal, epidermal?
- What about DTPI?

Ultrasound Studies

- Hard to read if novice, research limitations
 - evolution of injury
- Limitations of research
- Ethical considerations
- Cost?
- Speed?
- How Often?

US of Pressure Injury

- **Phase 1:** pockets of edema in the tissue between the bone and the dermis
- **Phase 2:** spread of the edema into the dermis
- **Phase 3:** increased subdermal edema with frank dermal edema and subepidermal edema or pooling of fluid

—Quintavalle PR, Lyder CH et al. *Ad Skin Wound Care* 2006

Deep Tissue Ultrasound

- Intermediate-frequency (10-MHz)
- 12 subjects
- Abnormal US findings in deep tissue of individuals with pressure injuries
- 1,2, Unstageable pressure injuries present

—Aoi N et al. *Plast. Reconstr. Surg.* 2009

Deep Tissue Ultrasound

- Followed injury progression
- IV, Healed, Unstageable
- No DTPI developed or were tracked
- Discontinuous fascia may predict progression of pressure injury

—Aoi N et al. *Plast. Reconstr. Surg.* 2009

Ultrasound and Thermography

- 21 patients with 28 pressure injuries
 - Stage 1 or 2 initially
 - Tracked for 1 week

—Higashino T. et al. *Int Wound J* 2012

—Nakagamo G et al. *Wounds* 2011

Ultrasound and Thermography

- Deep tissue
 - High on thermographic assessment
 - Heterogeneous hypoechoic area findings
- Injury with an unclear layered structure and increased temperature
 - Risk of delayed wound healing or wound deterioration was 6.85 times higher

—Higashino T. et al. *Int Wound J* 2012

—Nakagamo G et al. *Wounds* 2011

US vs MRI

- MRI Gold Standard
- Is it realistic?
- When would we do?
- Transport
- Cost

US vs MRI

- 6 subjects
 - 2 w/o SCI, 2 w/ recent SCI, 2 with long-term SCI
- Confirm ultrasound as an imaging modality for acquiring measurements of internal anatomical features associated with DTPI risk
- Ultrasound imaging is a viable methodology for measuring the unique bone and soft tissue features that affect the risk of deep tissue injury

Dilemma

- If we don't know what we are looking for, how do we know when or how to measure it?

Need more research

- Ongoing work
- Technology developing
 - May make visual/palpable assessment obsolete
 - or enhance it

Staging is Not the End

- Staging is the start
- CMS
 - Action item based on staging
- How will it impact how we treat / prevent / study?
- Alternatives to visual and palpable
 - Technology is on the horizon

Change is Hard





Thank You!!

Questions?