Skin Breakdown:
What You Should Know About Pathology and Technical Solutions For Prevention
Alpine Medical Rehab Conference 2014
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Objectives
- List the major extrinsic causes of skin breakdown, the mechanisms of damage and at least 5 intrinsic risk factors and how they contribute to pathology
- Define the principles of pressure redistribution and at least 3 ways to reduce peak pressures through seating and mobility solutions
- Describe at least 2 ways to reduce friction and shear through seating and mobility solutions
- List the items that should be included in the documentation to justify equipment components that are chosen to prevent or reduce skin breakdown

The Grim Statistics
- > 2.5 million skin breakdowns / yr in U.S.
- Incidences of up to 24% in long-term care, 38% in acute care and 17% in home care
- Inpatient costs = $11 billion in 2006
- Average lengths of stay = 13 to 14 days
  - Average for other conditions = 5 days
- Average costs = 6,000 - $20,000
  - Average for other conditions = $10,000
http://www.hcup-us.ahrq.gov
http://en.wikipedia.org/wiki/Skin_breakdown
Why Should You Know About Skin?

- Know the mechanism in order to help to identify the cause
- Help to identify other risk factors
- Identify cases when skin breakdown isn’t due to the wheelchair cushion
- Choose appropriate equipment solutions to remove causes, promote healing and prevent new breakdown

Layers of the Skin

<table>
<thead>
<tr>
<th>Epidermis</th>
<th>Dermis</th>
<th>Hypodermis (adipose)</th>
<th>Muscle</th>
<th>Bone</th>
</tr>
</thead>
</table>

Epidermis

- Mostly keratinocytes that produce keratin
  - Protective barrier against mechanical injury and harmful substances in environment
    - Keeps needed moisture in
    - Keeps unwanted moisture out ("waterproofs")
  - Absorbs nutrients
  - Helps regulate body temperature (sweating)
  - No blood vessels
  - ~ 0.4 mm thick
  - Millions of cells / day are shed from the body
Dermis

- Primarily connective tissue that contains:
  - **Blood vessels** that regulate temperature and provide nutrition
  - **Sebaceous glands** to lubricate the skin
  - **Sweat glands** to regulate body temperature
  - Cells involved in healing
  - Hair **follicles** and hair **roots**
  - **Sensory receptors** for pain, touch, hot, cold
  - **Elastin** for elasticity
  - ~ 0.5 mm thick

Hypodermis

- Dense connective tissue and subcutaneous fat
  - Produces **hormones**
  - **Attaches** skin to underlying bone and muscles
  - Contains **blood vessels** and **nerves**
  - Serves as **padding** and **insulation** for deeper structure below
  - Acts as **shock absorber** for the body
  - **Stores** water and fat

Names

- **Misnomers**
  - Decubitus (Latin for "to lie down")
  - Other positions can cause skin breakdown
  - Pressure ulcer
  - There are other causes besides pressure
  - Bed sore
  - Other environments also cause breakdown

- **Appropriate names**
  - Skin breakdown
  - Skin ulcer
  - Skin wound
Causes - Pressure

- Soft tissue is compressed between bony prominence and external surface
  - Build-up of peak pressures on vulnerable bony areas over prolonged time
  - Blood vessels are compressed
  - Blood flow is impeded and swelling occurs
  - Lack of oxygen causes cell death in epidermis
  - If pressure continues, death in underlying layers
- The underlying cause is **ischemia**

Causes - Pressure

- Soft tissue is compressed between bony prominence and external surface
  - Force deforms the shape of the cell
  - Change in cell membrane → change in permeability → cell death
  - May include cells involved in healing
  - Pressure near bony area → increased forces → increased deformation
- Underlying cause is **cell deformation**

Causes - Pressure

Breakdown is typically fairly symmetrical with even edges
Causes – Friction and Shear

- Skin stays in place on support surface while bony structure moves or slides
- Skin and soft tissues are caught between opposing forces
  - Blood vessels are pinched, twisted or ripped
  - Blood flow is impeded
  - Lack of oxygen
    - Ischemia  ➔ cell death

Causes – Friction and Shear

Shear forces can be even more destructive to tissue than pressure

Breakdown is typically asymmetrical or uneven with ragged edges

Causes - Moisture

- Prolonged moisture over-hydrates skin
  - Skin is softer, more vulnerable
  - Removal of oils increases risk of tears
  - Decreases resiliency of epidermis
  - Decreases strength of underlying connective tissue
  - Urinary or fecal incontinence changes pH of skin, increasing permeability/risk of irritation
  - Increases friction between skin and sitting surface, which increases risk of shear forces
Causes - Moisture

- Moisture can be due to:
  - Excessive sweating
  - Incontinence
  - Wound drainage

- Breakdown is typically asymmetrical or uneven with ragged edges
- May occur in areas other than under bony prominences

Causes - Other

- Reperfusion injury
  - Blood vessels quickly refill after flow has been significantly decreased/cut off by compression
  - Return of flow disrupts capillaries and causes increase in oxygen free radicals

- Impaired fluid flow in interstitial spaces or lymphatic system
  - Pressure or force disturbs normal removal of metabolic waste in and around cells
  - Results in tissue death

Intrinsic Risk Factors

- Aging skin
  - Drier, thinner, more fragile, less elastic
  - More vulnerable to damage from pressure, friction, shear, moisture
  - Compounded by loss of collagen and muscle

- Incontinence
  - Over-hydration increases vulnerability
  - Harmful bacteria leads to infection
Intrinsic Risk Factors

- **Poor nutrition and dehydration**
  - Deprives skin of required amount of protein, Vitamin C, Vitamin A, zinc and fluid
  - More vulnerable to damage
  - Less able to heal and repair
  - More susceptible to infection

- **Overweight**
  - Increased body weight creates more pressure
  - Obesity does not provide “padding”
    - Fat is compressible, not supportive like muscle
  - Diet often high in sugar and fat
  - Skin folds collect moisture, bacteria and fungus

- **Underweight**
  - Decrease in muscle mass and fat over bony areas

- **Impaired mobility**
  - Cannot perform effective weight shifts
  - Muscle atrophy exposes bony prominences
  - Paralysis causes loss of collagen
  - Decreased/absent muscle contractions contributes to decreased circulation

- **Impaired sensation**
  - Cannot feel need for weight shift
  - Cannot feel extremes of heat and cold
Intrinsic Risk Factors

- **Postural deformities**
  - Excessive pressure on more vulnerable areas not capable of taking a "load"
  - Sacrum, coccyx, ischial tuberosity, vertebrae

- **Pain**
  - Person shifts into harmful postures

- **Deconditioning / poor immune system**
  - Less ability to "cope" with pressure and shear
  - Impaired ability to repair and heal
  - Impaired ability to fight infection
  - A relatively small area of damage that would normally heal quickly can develop into a significant breakdown with infection

- **Cognitive deficits** – cannot remember to or is unaware of need to:
  - Avoid harmful activities, postures, other risks
  - Perform effective weight shifts
  - Perform skin checks
  - Address emerging damage

- **Behavioral issues**
  - Refusal to do any of the above
  - Poor caregiver assistance
Stages of Pressure Ulcers

**Stage I**
- Non-blanchable **redness** of localized area of intact skin usually over a bony prominence
  - May be painful, firm, soft, warm or cool compared to adjacent tissue
  - No actual break or open sore
  - May indicate “risk”
  - More difficult to detect with dark skin tones

**Stage II**
- **Partial thickness loss** of epidermis and dermis
  - May be shallow open ulcer with red/pink wound bed with no dead tissue
  - May be intact or open serum-filled blister
  - Does not include wound caused by tears, tape burns, dermatitis, maceration or scraping
Stage III

- **Full thickness loss** of epidermis, dermis and subcutaneous tissue
  - Muscles, tendons and bone not exposed
  - Slough (dead tissue) may be present
  - May be shallow if area has little subcutaneous tissue (occiput, malleolus, coccyx)
  - Much deeper if location has more fatty tissue

Stage IV

- **Full thickness loss** of skin and subcutaneous layers, exposing muscle, tendon and bone
  - Can extend into muscle, fascia and joint capsule
  - Osteomyelitis is possible
  - Slough or eschar may be present
  - Depth may vary as with Stage III
  - May include undermining and tunneling

Suspected Deep Tissue Injury

- Area of purplish intact skin or blood-filled blister with no / very small actual open area
  - Much more significant damage underneath
  - Area may be painful, firm, mushy, boggy, warmer or cooler compared to adjacent tissue
  - May progress to thin blister then rapid progression to affect additional layers of tissue
Unstageable

- Full thickness loss with base covered by dead tissue
  - Cannot identify actual depth and Stage until enough dead tissue is removed to expose wound base
  - Stable eschar on heel that is dry, adherent and intact without redness should not be removed

Undermining

- Damage spreads outward underneath the actual wound opening
  - Causes separation between two layers of tissue
  - Wound bed on outside may look relatively small
  - Invisible pocket of internal damage progresses outward from wound edge

Tunneling

- Deceptively small round open wound
  - Narrow progression of damage tunnels downward and outward into underlying tissues
  - Pocket or cavity at the end
  - Tunnel can progress into another body cavity (i.e., from ischial tuberosity into hip joint)
Staging the Healing/Healed Wound

- Healed wound is always vulnerable
  - Skin is ~80% as strong as before
  - Weak junction between intact skin / scar tissue
  - Muscle and soft tissue do not regenerate
- Never reverse stage a wound
  - Ulcer always stays the same “Stage”

Name of a Stage III wound beginning to close:

**Incorrect**
- Stage II ulcer

**Correct**
- Stage III ulcer, healing
- Stage III ulcer that presents like a Stage II

Breakdown Not Due to Pressure

- Describe by the layers of tissue involved

<table>
<thead>
<tr>
<th>Appearance</th>
<th>Description/Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presents like Stage II ulcer</td>
<td>Partial thickness wound</td>
</tr>
<tr>
<td>Presents like Stage III ulcer</td>
<td>Full thickness wound involving epidermis and dermis</td>
</tr>
<tr>
<td>Presents like Stage IV ulcer</td>
<td>Full thickness wound involving epidermis, dermis and muscle</td>
</tr>
</tbody>
</table>

- Could also add the cause, i.e.:
  - “Full thickness wound caused by shear involving the epidermis and dermis (presents like Stage III)”

Results of Skin Breakdown

- Skin, soft tissue, connective tissue damage
- Potential damage into muscle and bone
- Discomfort and pain
- Loss of mobility
- Long healing process, extensive treatment
- Infection → gangrene → amputation
- Surgical repair, hospitalization, pain
- Complications from bedrest
Results of Skin Breakdown

- Complications of prolonged bedrest
  - Decreased bone density
  - Increased risk of LE DVT’s
  - Decreased appetite leading to poor nutrition
  - Decreased motility in the g.i. tract
  - Increased risk of pneumonia
  - Increased rate of UTIs
  - Depression, anxiety, psychosocial complications
  - Weakness and gradual muscle atrophy
  - Decreased endurance
  - Development of joint contractures

Guidelines to Reduce Extrinsic Causes

- Reduce peak pressures, particularly under bony or vulnerable areas
- Minimize harmful shear and friction forces
- Optimize the microclimate
- Facilitate blood flow
- Decrease discomfort and pain

Reduce Peak Pressures

- We can never truly “relieve” pressure, we can only “redistribute” it over a surface area
- \[ P = \frac{F}{A} \] (pressure = force ÷ area)
  - To decrease peak pressure at any one point we must either decrease force or increase area over which total pressure is distributed

Small surface area, large peak pressures
Larger surface areas, better pressure distribution
Reduce Peak Pressures

- In seating we must avoid peak pressures under/around vulnerable areas:
  - Sacrum, coccyx, ischial tuberosities
  - Spinous processes, occiput
- Strategies:
  - Distribute pressure totally away from a vulnerable area for short time periods
  - Increase the area over which the pressure is distributed around the vulnerable area

Temporary “Relief”

- Frequent and effective weight shifts

Use Shape

- Conform to anatomical shape using contour
Use Shape
- Conform to anatomical shape using materials
  - Allow compression into the material 😊
  - Allow envelopment into the material 😊😊😊

Correct Any Equipment Issues
- Poor equipment causes poor posture that increases pressure on vulnerable areas
  - Footrests too high or too low
  - Armrests too high or too low

Correct Any Equipment Issues
- Seat to back angle does not match anatomical shape
Correct Any Equipment Issues

- Poor support under pelvis
- Back support too high or too low

Correct Any Equipment Issues

- Seat too wide
- Seat too short
- Seat too long

Reducing Shear

- Provide support and stability to reduce risk of sliding into abnormal postures
  - Supportive and appropriately contoured seat cushion and back support
  - Appropriate secondary supports
Reducing Shear

- Provide support and stability to reduce risk of sliding into abnormal postures
  - Wheelchair components / configurations

  Tilt in the frame
  Open or closed seat to back angle

Reducing Shear

- Materials that “move” with individual but still provide necessary support and stability

Reducing Shear

- Options other than standard recline
  - Tilt in space
  - Reduced shear power recline
Look Beyond the Wheelchair

- Assess need for “padding” on other surfaces
  - Commodes
  - Raised toilet seats
  - Shower chairs, tub benches
  - Geri-chairs
  - Armchairs
- Avoid layers over skin protection materials

- Assess transfer method and transfer equipment to prevent shear
  - Sliding board
  - Patient lifter
  - Track lift

- Consider where most individuals spend ~1/3 of the day - the bed
  - Turning and repositioning schedule
    - Pillows between bony prominences
    - Wedges or pillows to raise heels off bed
    - 30° lateral side-lying vs direct side-lying
    - For prolonged periods, no more than 30° of elevation of the head of the bed
    - When sitting, match hip joint to “joint” of bed
    - Pressure-reducing overlays or mattresses
Managing Microclimate

- Effective and timely management of incontinence
- Avoid hot water and cleaning agents that dry skin
- Moisturizers for dry skin
- Absorbent surgical dressings for wound drainage
- Avoid hot, humid conditions and sweating
- Cushion and back covers that wick away moisture and allow air flow
- Avoid incontinent-proof covers that keep urine and feces close to skin

Educate to Reduce Intrinsic Risk

- Good nutrition with adequate protein, vitamins
- Good hydration with adequate water intake
- Weight loss or weight gain as appropriate
- Increase mobility to improve circulation
- Discourage smoking
- Protect aging skin against dryness and injury
- Manage pain
- Education re: causes/prevention of skin breakdown

Documentation

- Documentation requirements may be specific for certain types of products or for certain funding sources:
  - Wheelchair seat cushion
  - Therapeutic support surface
  - Surgical dressings
  - Negative pressure wound therapy
  - Specific kind of tub bench, commode or shower chair
  - Feature or configuration of a wheelchair
Documentation

- History of the breakdown (onset, progression)
- Location - with ICD-9 code if appropriate
  - Buttocks (707.05), hip (707.04), sacrum (707.03)
  - Upper back/scapula (707.02)
- Qualifying diagnosis if needed
- **Primary cause(s)** and intrinsic risk factor(s)
- Any contributory equipment factors
  - WC, cushion, bath equipment, bed, vehicle seat
  - Type and effectiveness of transfers, weight shifts
- Current or past treatment methods

Documentation

- Stage or description
- Shape - round, oval, rectangular, irregular
- Size - width, length and depth in cm
- Edges - distinct, indistinct, rolled, scarred
- Undermining or tunneling
- Exudate - amount, color, odor
- Presence of infection and/or necrosis
- Description of surrounding skin
- Associated pain
- Degree of healing

Documentation

- Record length and width using points on face of a clock as reference points
- Record depth in center or at deepest part

Length from 12:00 to 6:00 = 4.5 cm
Width from 3:00 to 9:00 = 3 cm
Depth in center = 0.5 cm