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Three Extrinsic Factors of Wound Development:

Taking a deeper look

Ana Endsjo. MOTR/L, CLT

Faculty Disclosure

Ana Endsjo– MOTR/L, CLT
National Education Manager- Long Term Care Division

CONTINUED

Objectives

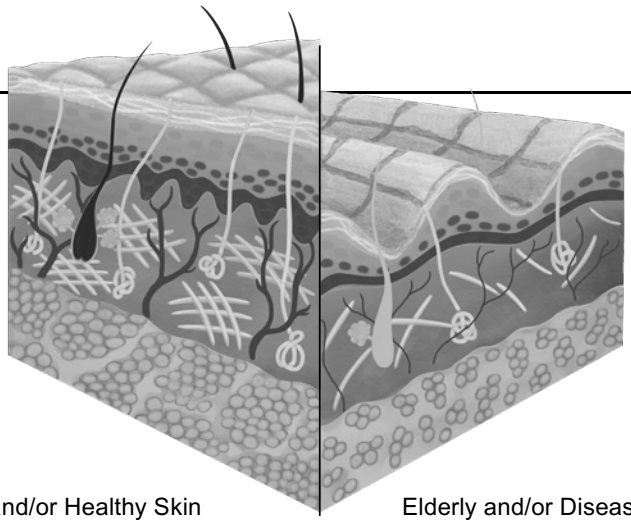
1 Name two pressure redistribution methods to protect a client from peak pressures on bony prominences.

2 Name two ways that shear can occur while sitting in a wheelchair.

3 Name two properties to look for in a cushion cover to fight microclimate.

Natural progression of aging

Natural age-related skin changes compromise the skin integrity, making an elderly client more susceptible to wound development when the extrinsic factors of pressure, shear and microclimate are present.



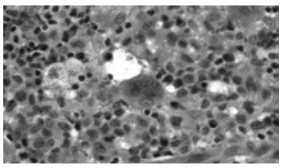
Young and/or Healthy Skin

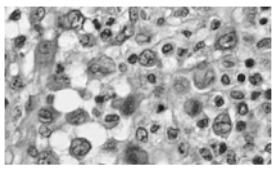
Elderly and/or Diseased Skin

Skin Changes

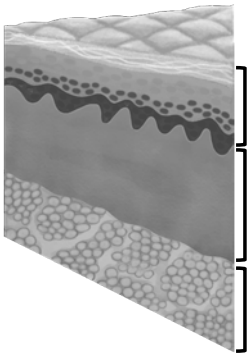
Loss of the oily coating that protects, hydrates, the epidermis

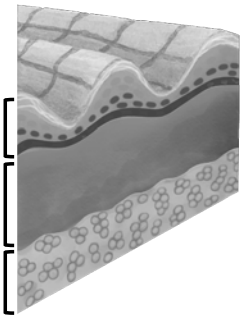
Decrease in Langerhans cells- diminished initial warning signs of injury, increased processing time when injury occurs





Thinning of each layer of skin reduces the barrier between pressure source and soft tissue





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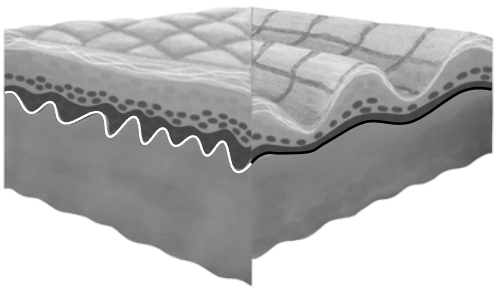
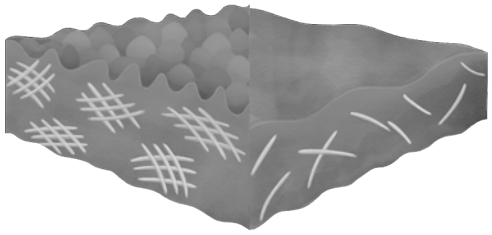
Skin Changes

Flattening out of the dermal- epidermal junction decreases blood flow and the exchange of O_2 and nutrients needed to maintain skin integrity and aid in wound healing



Decreased collagen and elastin production weaken reduce tensile strength and flexibility of the skin to fight against outside pressure and trauma



Decreased moisture content coupled with a decrease in elastin fibers minimize the viscoelastic property, the skin and deeper tissues are more susceptible to shear forces

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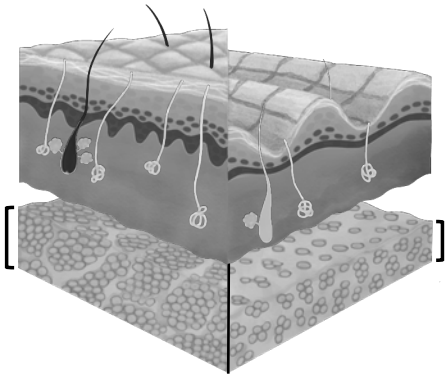
Skin Changes

Decreased number of sweat glands diminish the ability to dissipate heat

Decreased sebaceous glands weaken the waterproof barrier allowing excess moisture to macerate the skin

Excess moisture increases the skin's co-efficient of friction, increasing the susceptibility to shear forces

Reduction of the fatty layer decreases the body's ability to fight off extreme temperatures and absorb excessive shock and trauma to the skin and deeper tissues



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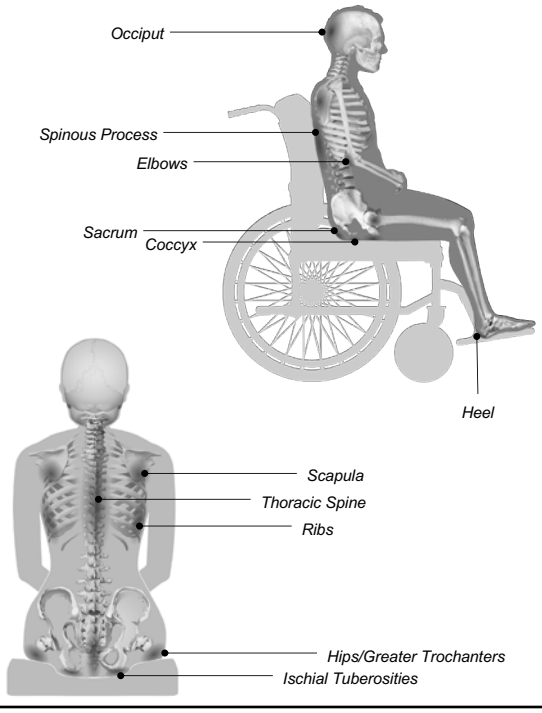
Common areas of skin breakdown

- Ischial Tuberosity
- Coccyx
- Sacrum
- Greater Trochanters
- Spinous Process of Vertebrae
- Scapula
- Rib Cage
- Occiput
- Heels



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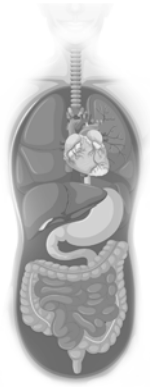
Causes of wound development: INTRINSIC FACTORS

Factors stemming <u>from within the body</u> that make an individual more susceptible to wound development



- Age related skin changes
- Poor nutrition and dehydration
- Urinary and fecal incontinence
- Limited mobility
- Impaired sensation
- Postural deformities
- Medical conditions affecting blood flow
- Obesity
- Being Underweight
- Limited Alertness
- Muscle Spasms
- Smoking

Causes of wound development: **EXTRINSIC FACTORS**

Factors that stem from the environment that a therapist can address directly through equipment choices

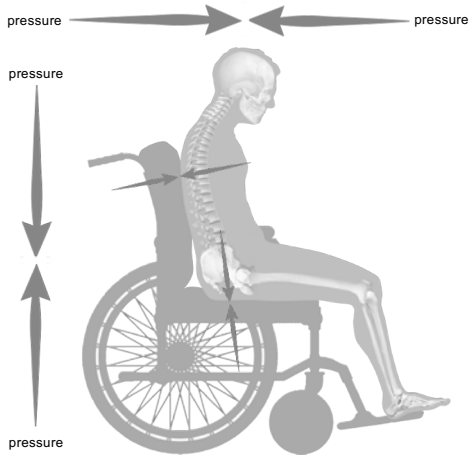
Prolonged Pressure

Shear

Microclimate

Understanding Pressure

Understanding Pressure

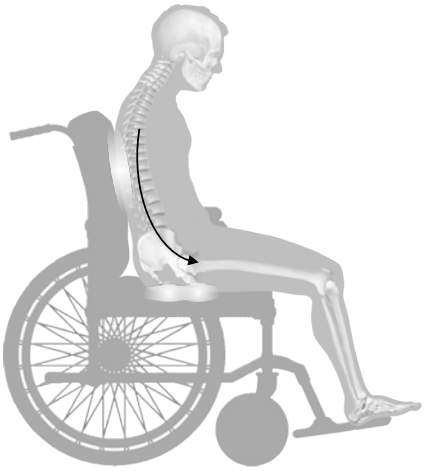


Pressure

- Is a continuous force applied on or against an object by something in contact with it
- Creates peak pressures under bony prominences
- Leads to skin breakdown without pressure redistribution through the appropriate cushion, back support and wheelchair configuration

When is pressure at its peak?

- Clients with poor trunk and pelvic strength slide into an abnormal posture, unable to reposition themselves
- With the use of cushions and back supports with poor pressure redistribution properties (skin protection properties)
- Use of a sling back and/or general use cushion without built-in postitioning properties
- Focusing on the cushion alone, forgetting the critical role the back support plays in an optimal seating system
- Sitting in an ill-fitting wheelchair system with angle configuration that does not match the client's ROM limitations



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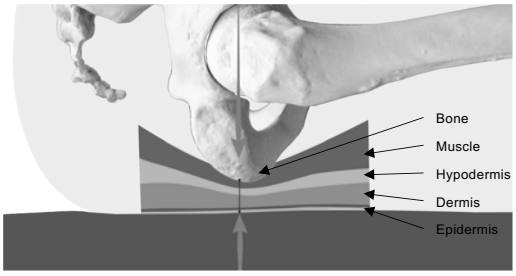
Understanding Pressure



Initially, it affects only the superficial, **epidermal layer**, causing a reddening of the skin. Skin is still intact.

(Stage 1)

Eventually, the pressure impacts the **dermis**, breaking the skin open, causing an open wound

(Stage 2)

Continued pressure damages deeper into the **hypodermis** now affecting all 3 layers of skin.

(Stage 3)

Injury depth reaches the tissue under the skin, potentially as low as the **muscle** and **bone**

(Stage 4)

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Understanding Shear

The Silent Extrinsic Factor

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Shear - a difficult concept for healthcare providers to grasp

Barriers:

- Lack of understanding what friction really is and the different types of friction
  - Types of friction
- Ignorance to what type of friction is injuring the soft tissues **in the seated posture**
  - Support surfaces and coefficient of static friction
- Shear is commonly misconceived to be friction alone
  - Shear is defined as a combination of downward pressure AND static friction
- Poor knowledge of how and when shear occurs in the wheelchair system
  - Movement begins due to downward pressure coming from gravity
- Lack of education to understand the severity of a pressure injury caused by shear
  - Why is it more dangerous than a wound caused by pressure alone
- Little education on how to effectively fight shear with the appropriate equipment choices
  - How to tackle shear through wheelchair configuration and equipment choices

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Types of Friction

Fluid	• Occurs when a solid surface moves through a fluid
Rolling	• Occurs when an object rolls across a surface
Dynamic/Kinetic	• Exists in a body that is already in motion • It's what makes moving objects slow down and stop
Static	• "Gripping" friction - force keeping an object at rest. • Static friction resists the beginning motion of one body over another and must be overcome to start the object in motion • Physical wear and tear of objects is a major negative effect of static friction.

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Support surfaces and coefficient of friction

Cushions, backs supports, and secondary support surfaces are made with a high co-efficient of fiction

- A low coefficient of friction creates low resistance of one surface sliding across another, **allowing freedom of movement** – *Example: ice*

- A high coefficient of friction creates high resistance of one surface sliding across another, **preventing movement** – *Example: denim or concrete*

- **Static friction** is greater in materials with a **high coefficient of friction**
- The skin and soft tissue "grip/stick" to the support surface to keep the person from sliding out of the wheelchair

High CoF is needed to prevent slipping out of the wheelchair

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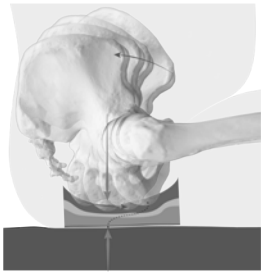
Movement begins to occur due to **downward pressure coming from gravity**

The shearing occurs when skeletal structures move "inside the skin" at the pelvis and spine

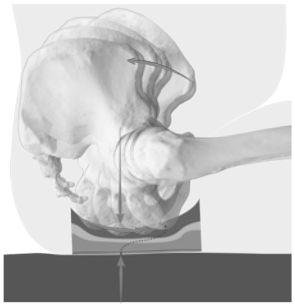
- The movement can be voluntary or involuntary movements:
  - A client in an ill-fitting wheelchair that slides into an abnormal posture due to gravitational pull
  - A lack of pelvic and/or trunk stability to maintain posture against gravity
  - Agitated client shifting, repositioning, and reaching while in the wheelchair system
  - Transfers in and out of the chair
  - Repositioning a client multiple times in the wheelchair system



Ex: Reaching for a cup coffee at your desk, the body doesn't move, but the pelvis does

Shear is defined as a combination of **downward pressure** and **static friction**

Skin/soft tissue, "stick" to the seat surface while the bony prominences continue the path of movement



Downward pressure from gravity pull the skeletal structures "inside the skin" into movement

+

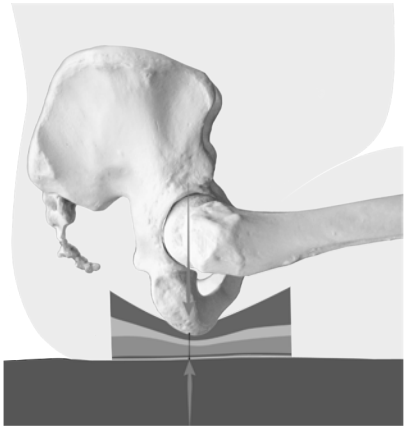
Static Friction = Brakes
Skin and soft tissue "gripped" by the support surface to prevent movement

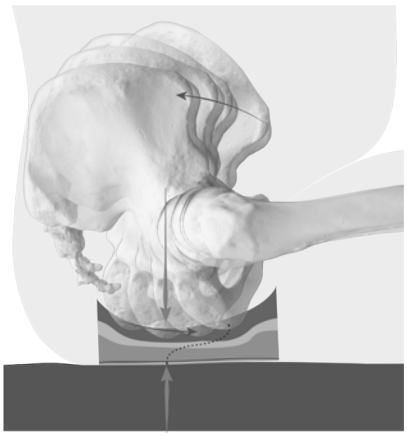
=

Shear Pressure Injury: **Deformation of cell structure** of **deep layers** of tissue and **tearing of blood capillaries** leading to permanent cell death and skin breakdown.

The mechanics of

Pressure **vs.** **Shear**





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The mechanics of PRESSURE

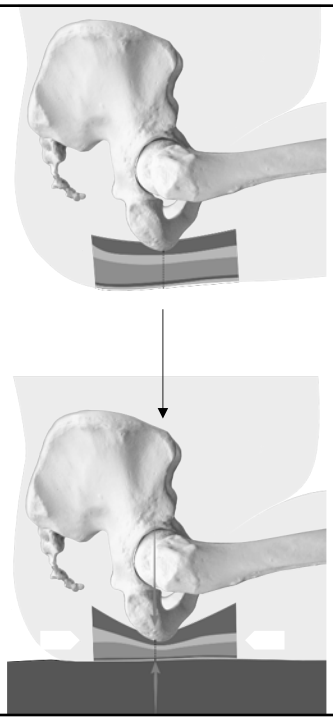
Client sits in a static posture for **prolonged** periods of time

Peak pressures develop at the bony prominences caused by the constant downward pressure from gravity plus the upward pressure from the seat surface

The skin/soft tissue between the bony prominences and the seat surface is **constantly being compressed**

The lack of blood flow, O_2 and nutrient delivery results in ischemia

Tissue Death/Pressure Injury 



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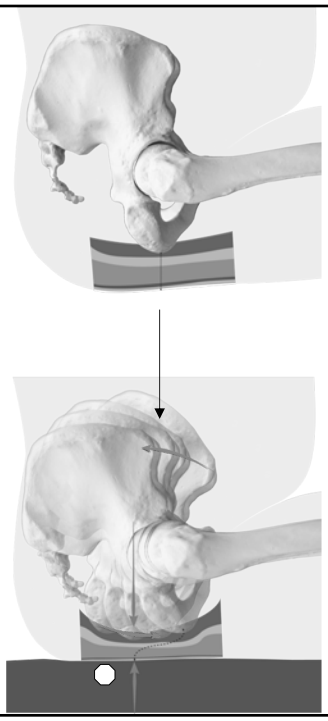
The mechanics of SHEAR

Gravity causes downward pressure	→ The **tissue is strained** by the opposing forces
The pelvis/spine **move** in the wheelchair	Permanent **cell deformation** at the deeper layers of tissue
Support surface with high coefficient of friction causes skin to "stick" to seat surface	**Blood capillaries tear** & damage decreases oxygen delivery
The skin/tissue at the seat surface sticks while the underlying bone structure moves	Ischemia amplified
	Tissue Death/Pressure Injury



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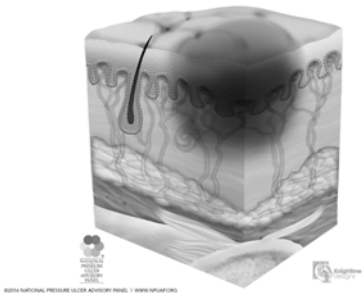
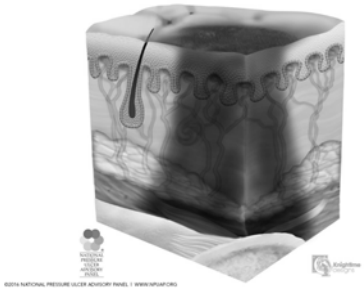
Why is shear **so dangerous?**

- More familiarity with a wound caused by pressure
- Starts superficially, opening as it progresses
- **Visual signs** are noted:
  - Reddening of the skin
  - Temperature change



- A shear wound forms at the bone/muscle interface
- Expand outward to the surface of the skin
- **Minimal to no visual signs and** may remain closed- "Silent"
- Once visible, very advanced stage, all layers of the skin/tissue effected



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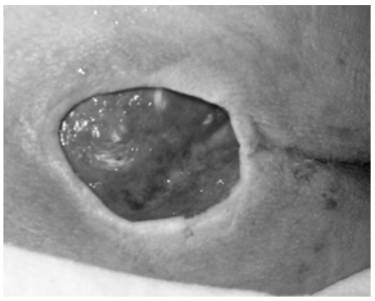
Presentation of a wound

Pressure



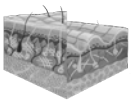
- More symmetrical, circular or oval in shape with even edges
- Usually under a bony prominence due to the peak pressures

Shear

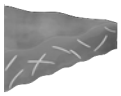
- Asymmetrical, ragged and uneven in shape
- Initiates deeper moving outward toward the superficial layer of the skin

Why is shear **more dangerous** for the elderly?

Age related skin changes make the skin more susceptible to shear



- Thinner skin with more fragile blood vessels tear more easily with shear forces, causing permanent cell deformation

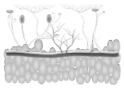


- Disorganization and loss of collagen & elastin fibers, cellular strength is lost, easier to permanently deform cellular structure from downward pressure and friction applied to the soft tissue

- Elastin fibers are fewer in number and water content of the skin is diminished causing a loss of the viscoelastic property. When shear forces are applied, the skin can no longer deform then return to its baseline shape, resulting in **permanent** cell deformation and death

Why is shear **more dangerous** for the elderly?

Age related skin changes make the skin more susceptible to shear



- Fibrous bands and connective tissue in the hypodermis that anchor the skin to the deeper tissue is lost, the skin less firm and resilient. When the static fictional force ("the brakes") is applied, easier to distort the cells of deep tissue and tear blood vessels causing permanent deformation and death of the soft tissue

- Decreased blood flow, O_2 & nutrients exchange between the layers of the skin, slows healing time when an injury has occurred

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Understanding Microclimate

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Understanding Microclimate

Microclimate is:

The climate of a very small or restricted area, that differs from the climate of the surrounding area

In the seated posture, it occurs where the body and support surfaces make contact usually under the bony prominence where pressure is at its peak

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Understanding Microclimate

Microclimate is created due to excessive heat and moisture from:

1. Increased body temperature at skin surface
2. Increased humidity or skin surface moisture due to:
   - sweat
   - urinary or fecal incontinence
   - drainage from wounds
3. Sitting on a non-breathable seat surface, preventing ventilation due to a lack of adequate airflow

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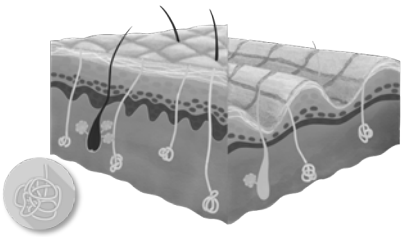
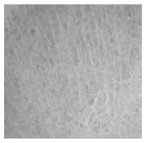
Remember, due to natural age changes, the elderly client is more susceptible to microclimate due to:

Decreased number of sweat glands at dermis
Less sweat produced and excreted to epidermal surface



The client cannot cool body temperature down by evaporating excess moisture at the seat surface

Decrease in sebaceous glands at dermis
Less sebum production and oil secretion at the epidermis



Decreased sebum (oil) production equals drier, more brittle skin

Loss of the waterproof barrier allows for easier maceration of the epidermis when incontinence, sweat and drainage from a wound are present

Microclimate increases the effects of pressure and shear

Elevated Body Temp
- Increases the metabolic rate
- Demanding more O_2 to be delivered to the tissues
- Pressure and shear cut off O_2 supply
- Ischemia occurs more quickly with **pressure and shear** when the body temperature is raised

Excess Moisture
- Increases the skin's co-efficient of static friction
- Skin and deeper tissues "stick" more easily to the seat surface when **shear** forces are applied

Excess Moisture
- Increases the risk of maceration
- Weakens fibrous connections, weakening and thinning the layers of the skin
- Exposes deeper blood vessels and soft tissue
- Increases likelihood of damage from **shear and pressure**

Fighting the extrinsic factors of wound development

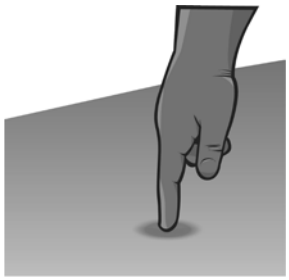
What the therapist **<u>can</u>** do to fight pressure, shear, and microclimate

Fighting Pressure

Increase surface area contact

Rule of thumb: the greater the surface area, the smaller the peak pressure!

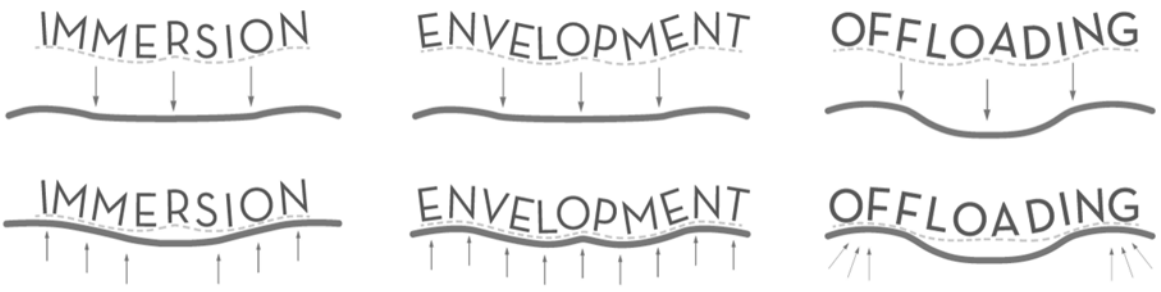
Force when concentrated in a small surface area creates peak pressures. Applied pressure when spread out over a greater surface area, allows for a reduction in peak pressure even if the same amount if force is applied.



Peak pressures without pressure redistribution

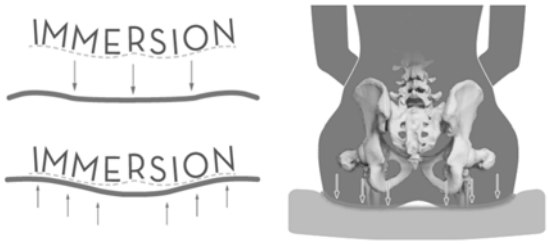
Pressure Redistribution: Creating the greatest contact surface area

Immersion	Immersion with Envelopment	Offloading or Partial Offloading



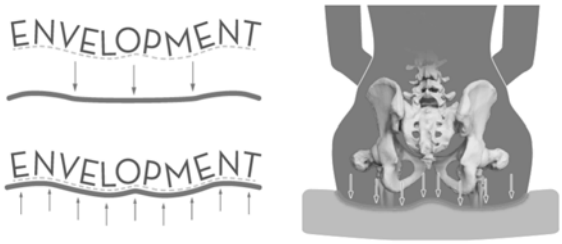
Pressure Redistribution Methods: Immersion and Envelopment

The principle in which a material allows the body to "sink" into it and provide some pressure redistribution.



This automatically increases surface area

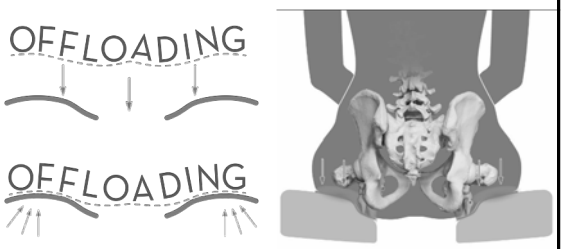
The principle in which a material allows the body to "sink" into it **while** the material conforms to the body's shape to create the greatest surface contact between the body and the support to reduce peak pressures



This further increases surface area

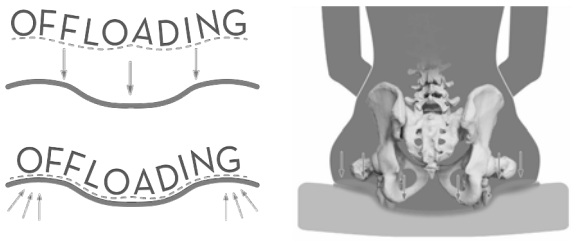
Pressure Redistribution Methods: Complete and Partial Offloading

Complete offloading is the principle in which pressure is completely removed from a small, vulnerable surface area and loaded onto a greater surface area of more tolerant tissue to provide pressure redistribution and reduction of peak pressures.



This relocates pressure to more tolerate areas

Partial offloading instead of completely removing contact from the small, vulnerable area, contact is still partially made between the body and support surface. Peak pressures are greatly reduced by being spread over a greater surface area. Highest pressure is still relocated to more tolerant areas of the body.



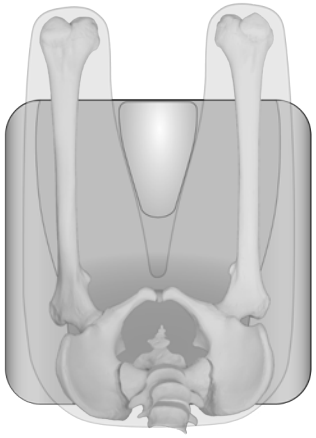
This relocates higher pressure and increases surface area

Contours needed to offload pressure

Lateral Tapered Adductors
Align the LEs and prevent abduction and external rotation for maximum femoral loading
Assist to lock in the trochanters

Medial Abductor
Align the LEs and prevent adduction and internal rotation for maximum femoral loading

Deep Posterior Pelvic Well
In combination with lateral tapered adductors, will offload and suspend the ITs, sacrum, and coccyx and load the femurs

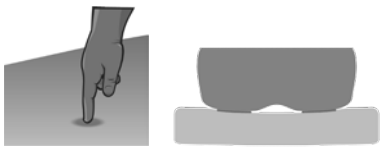


permobil CONTINUED

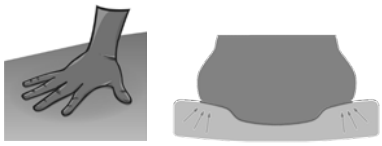
Though the contours of a cushion:

Offload to create pressure redistribution

Redistribute pressure off a tiny bony prominence with less surface area like the ITs…



onto the femurs, trochanters, and buttocks with greater surface area



Increase contact surface area and **increase stability** by locking the head of the femur into the acetabulum and **creating leg troughs for LE alignment** to reduce sliding into unwanted postures that create peak pressures

Stabilize the pelvis: Lock the head of the femur into the acetabulum.
Combination of tapered lateral adductors and a deep posterior pelvic well

Create leg troughs: Combination of medial abductor *(left)* and lateral adductors *(right)*

permobil CONTINUED

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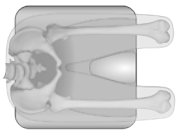
Fighting Shear

How to fight shear

Take into consideration the pressure AND friction component with equipment choices

- Reduce coefficient of static friction between the support surface and the skin and tissue

- Use mediums in equipment choices that move with and not against the movement of the underlying skeletal structures



- Through the geometry of the cushion and wheelchair configuration, create wheelchair systems that minimize unnecessary movement into unwanted postures and redistribute pressure away from small bony prominences

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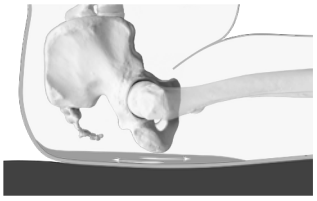
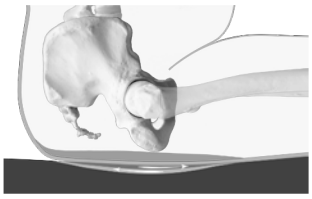
Protecting from Shear – Reduce the coefficient of friction

A support surface with a high coefficient of friction causes the skin and soft tissue to "grip/stick" to the support surface



Friction at the seat surface means shear is applied to the tissue between the seat and bone



Fabric with a **low coefficient of friction strategically placed** under the bony prominences in movement, allows the skin and soft tissue to move **with** the skeletal structure **instead of against the movement**

Friction and therefore shear forces are transferred to the low-friction fabric instead of the skin/soft tissue

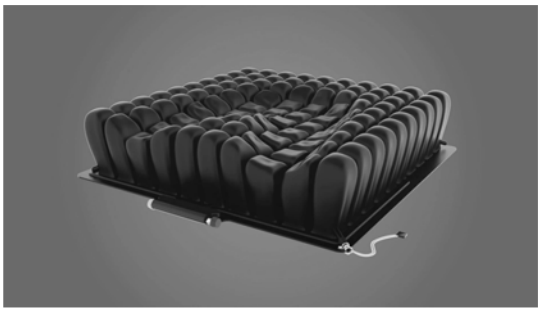
Significant reduction in shear forces that otherwise would cause cell deformation and tearing of blood vessels leading to permanent damage of the soft tissue

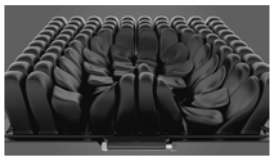
permobil CONTINUED

Protecting from Shear – Cushion medium

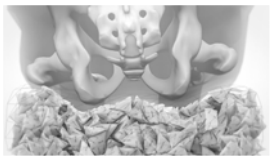
Use a medium that:

- Is made with a **low coefficient of friction** allowing the skin/soft tissue to move with the skeletal structure below instead of against it
- Allows for **immersion and envelopment**:
  - Air is a medium proven through studies to immerse and envelop the body while protecting the skin
  - The air allows the cushion to conform and shift with the body instead of fighting against the movement





Air cells shift and move with the body



Air cells conform to the body in any position

permobil CONTINUED

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Protecting from Shear - Decrease Pressure

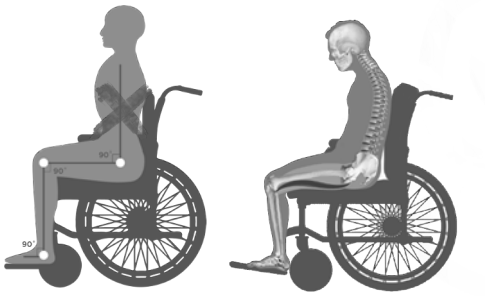
Reduce shear by **increasing pressure redistribution** and **decreasing unwanted movement** in the wheelchair:

- Look for cushion with pressure redistribution properties of either **immersion and envelopment** or **offloading**
- Consider the use of cushions with **contour** to help **lock in the pelvis and provide that added stability** to prevent unwanted movement that increases the risk of shear

Protecting from Shear - Decrease pressure

Avoid angles that increase the risk of sliding into abnormal posture, creating peak pressures at the pelvis and spine

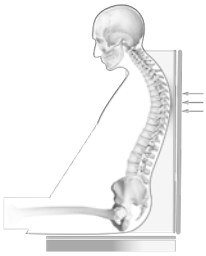
- Prevent clients from sliding into abnormal postures by placing them into wheelchair systems with fixed angles their body cannot tolerate
- Provide the wheelchair systems that have **adjustable angle** configuration to match the client's ROM limitations



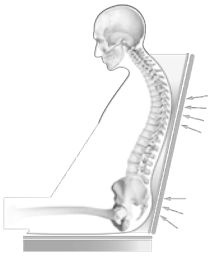
Protecting from Shear - Decrease Pressure

Recall the back support is just as critical as the cushion.
Provide back supports that **envelop, immerse,** and **capture the curvature of the spine to:**

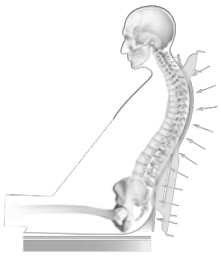
- **Make more contact** with seat and back support surface
- Provide **even pressure distrib**ution along the spine
- **Increase stability of the spine** and in turn the **pelvis** to minimize unwanted movement in the chair



90º STBA
Minimal surface contact with the cushion and back support



Open STBA
More cushion and back support surface contact for some pressure redistribution



Open STBA + Contour
Maximized surface contact for pressure redistribution & stability. Back support provides additional support for the pelvis

permobil CONTINUED

Fighting Microclimate

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Controlling Microclimate

Controlling microclimate **through better hygiene practices:**

Look at the client's ADL routine. Consider hygiene practices to ensure we are not promoting the microclimate that we are trying so desperately to avoid!

- Make a strict toileting schedule to minimize the negative effects of incontinence
- Avoid using hot water and harsh soaps when cleaning a client
- Apply skin barrier creams in sensitive areas
- Apply dressings to manage drainage from wounds
- Maintain a mild climate in the environment by avoiding excessive heat and humidity
- Wear breathable clothing and change briefs regularly

permobil CONTINUED

Controlling Microclimate

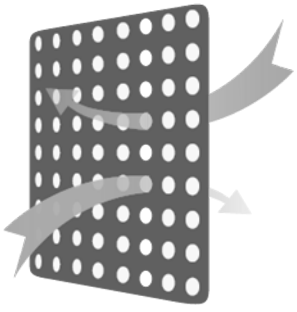
Controlling microclimate **at the seat surface:**

Search for products that are **moisture and air permeable**! Consider:

- Mesh liners
- Incontinence liners to prevent locking moisture into the cushion medium
- Breathable fabrics and clothing

Look for descriptors that fight microclimate when choosing a cushion such as:

- Heat Dissipation
- Air and Moisture Permeable
- Breathable
- Moisture Wicking
- Temperature Regulation
- Air flow



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When fighting the extrinsic factors of wound development…

KNOWLEDGE IS POWER!!!

Understanding the mechanisms, arms you with the tools to fight against them!

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