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The Aging Skin: Skin Changes, Wound Development, and  
Pressure Injuries in the Elderly  
in Partnership with The Permobil Academy  
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- [Fawn] Today's course is The Aging Skin, Skin Changes, Wound Development and Pressure Injuries in the Elderly, in Partnership with The Permobil Academy. Our presenter today is Ana Endsjo. She has worked as an occupational therapist since 2001, in a variety of treatment settings including acute care, subacute care, outpatient acute rehab, long term care and is a lymphedema certified therapist. She has worked mostly with the geriatric population focused on seating and positioning and contracture management of the nursing home resident. In January of 2016, she started a new role with Comfort Company as the clinical education manager for the long term care division, and then joined Permobil family in October of 2017, as clinical marketing manager. In this role, she developed an education program for long term care settings with the help to guide other therapists, rehab directors, nurses and administrators to understand the critical role proper wheelchair positioning plays in the prevention and treatment of serious health complications within Long Term Care Centers. Welcome Ana, so glad to have you.

- [Anna] Thank you so much Fawn, and I'm gonna go ahead and switch to my screen, so one moment as I do that. Okay. And again, thank you so much for having me. And for time sake, found it a great job of introducing me, I'm gonna go ahead and jump right into the objectives. And today's objectives are that I would like for you to number one, name two functions of the epidermis, dermis and hypodermis layers of the skin. Number two, list two age related changes that occur at each layer of the skin. And then lastly, name and describe one difference between each stage of pressure injury. Okay, so it is pretty well known that an ill fitting wheelchair system can and will increase the risk of our residents to slide into an abnormal posture, and then that in turn will increase their risks of multiple health problems, that arise from prolonged sitting in one of those abnormal postures. And one of the biggest risks with poor wheelchair posture is that dreaded wound. And this is a very, very hot topic in healthcare these days due

to a high incidence and cost to a facility, and the fact that if a setting allows a pressure injury to form, it could really impact future reimbursement.

So what I'm gonna do now is I'm gonna go through some examples of a nursing home setting to discuss just how prevalent the issue is, by reviewing some of these key statistics that you can see up on the screen. And the first statistic is that more than one in 10 nursing home residents have a pressure injury. So that's quite a few. The second statistic and I want you to remember this, 'cause I'm gonna talk about this again later on in the course, is that stage two wounds are accounting for more than 50% of those pressure injuries. Also, residents with recent weight loss are at a higher risk to develop a wound, and also residents with high immobility issues are at 11% greater risk than those without high immobility issues. And usually the next question I get asked when I say that statistic, is well, what do you exactly mean by high immobility? And that really refers to residents that spend all or most of the day in that wheelchair system. You know, they're usually not emulators, they are unable to reposition themselves in the chair, or need assistance to perform some type of pressure relieving technique.

Another really interesting statistic is that those residents that suffer from bowel and bladder incontinence are 12% greater risk at developing a pressure injury. And again, I want you to remember that statistic 'cause we're gonna discuss that more in depth when we look at microclimate. And pressure injury development and prevention are hot topics because they are a red flag for a facility that allows a wound to develop in their center. And you know, one thing that we need to start utilizing are higher end cushions and back supports, and more and more importantly to me, is understanding wheelchair configuration and setup to really help protect against the development and assist in the healing of an existing wound. And yes, I understand completely that higher end equipment has a higher upfront cost. But that is truly nothing in comparison to this last statistic that says that it cost \$43,180 to treat one pressure injury. And that's usually a stage one to pressure injury. When you start looking at maybe a flap surgery or stage

three or stage four deep tissue injury, that costs increases significantly. So sticking with this nursing home example, you know, I want you to really think about what kind of residence you have. And why do you think there's so much more susceptible to a wound development? And if you really just think about it, there's an estimated 70 to 80% of nursing home residents that are wheelchair users. And in my honest opinion, I've worked in a slew of nursing homes, that's probably even higher. And of that 70 to 80% of the nursing home residents that use the wheelchair, a good 40 to 80% of them need some type of intervention in order to prevent a pressure injury to the seated posture. And most of the wheelchair users are not mobile, we just talked about that, right? Or they have very limited mobility with two thirds of our nursing home residents using that wheelchair as their primary mode of locomotion. So that means that they're not just sitting in this wheelchair for like two hours at a time, they're sitting for four, six, maybe 10 hours at a time. And this is where we should be taking over as therapists; we need to come in, perform screens to really identify that at risk client that sitting in a wheelchair that's not configured to their body, we're trying to change their body to the wheelchair, pick them up for a seating position evaluation and get them the interventions that are needed.

So let's review some very important contributing factors that impact increase the risk of a pressure injury. And we've mentioned this a couple times, again, we're dealing with clients that are sitting in the wheelchair for hours on it, but really kind of puts them and makes them defenseless to the extrinsic factors of wound development if they're not positioned correctly. And we will be looking at those extrinsic factors, and they are pressure, shear and microclimate. As well, we're dealing with a population that has a lot of physical limitations. So you're looking at things like the lack of trunk and pelvic strength, that really prohibit the client from being able to maintain optimal alignment or readjust and sit themselves out into optimal alignment; if they fall out of it due to gravity or fatigue. And that increases their incidence of sliding into one of the five abnormal postures. And just kind of recap, the five abnormal postures are; you know

posterior pelvic tilt, an excessive anterior pelvic tilt, an obliquity, maybe a windswept deformity and then more in the thoracic and more in the spinal area of kyphosis, lumbar lordosis, spinal rotation, or scoliosis.

And as well, these clients have multiple comorbidities. You know, we're not only dealing with a client that has Parkinson's, for example, but they have a slew of other medical conditions such as diabetes, vascular insufficiency, nutritional deficits, that really make that skin much more vulnerable to skin breakdown. And then finally, unfortunately, whether we like it or not, our skin goes through some natural age related changes that increase our skin susceptibility to break down and wound development. And I think it's really important for us to understand what those skin changes are so that we can protect our elderly client a little bit better. And there are factors of wound development, and they are broken into intrinsic factors and extrinsic factors. And intrinsic factors are factors that are stemming from within our body. This is what makes an individual more susceptible to wound development because of changes that are occurring due to a disease process or maybe poor nutrition and so forth. You can see the list on the screen. These are things that the interdisciplinary team, so like the doctors, the pharmacists, the nutritionist, the nursing staff are working together to change something like the client's food intake or the medications that might make the skin more susceptible, or maybe some type of lifestyle change that will help to prevent them from developing wound.

The extrinsic factors on the other hand are factors that are stemming from the environment, affecting the body from the outside. And the extrinsic factors are prolonged pressure, shear and microclimate. And we as therapists, this is where we can step in and we can directly address these extrinsic factors through our wheelchair configurations and the equipment choices that we put them under, to decrease our client's risk of developing pressure injuries. So we can look for products that have built in properties that are the construction really minimize the impact of the pressure of

shear and microclimate. So the first extrinsic factor is prolonged pressure. And I really believe that this is the factor that most of us understand the best, because we feel it on a daily basis. You know, we're sitting here and if I don't shift or move, my bottom is going to go numb, from, you know, the ischemia that's happening when the soft tissue and the blood vessels are constantly being compressed. So it's easy for us to relate to our clients and understand how susceptible they are to pressure because we feel it, okay? So pressure, by definition is a continuous force that is applied directly on or against the skin that makes it more susceptible to a pressure injury. And we know that pressure usually occurs right at a bony prominence that creates what is known as a peak pressure; which are hot areas of high risk for skin breakdown. And in the seated of posture, the common areas that are susceptible to those peak pressures from prolonged sitting are at the ITs; so our ischial tuberosities, the sacrum, the toxics, the greater trochanter, especially if you're dealing with a very narrow chair or someone who's kind of sitting with a rotation in their chair, and definitely along the spinous process.

The second extrinsic factor is not nearly as well understood. And unfortunately, historically, it just wasn't taught in schools. And so some therapists if you went to school when I did or even earlier, it just was not talked about when they started talking about pressure injury, development and wound risk, etc. But that is definitely changing and the understanding of shear and the severity of damage to the soft tissue is now heavily studied. And so what that's doing to us as therapists who didn't really learn about this in school, is we're forced as therapists to now understand what it is, how it occurs, and how we can protect our patients through the appropriate wheelchair configuration and our equipment choices. And shear has two components. It's a combination of downward pressure coming from gravity and friction. And unfortunately, that friction component is usually misunderstood. And there is that misconception that friction is merely the rubbing of two surfaces against each other. And it's actually a lot more than that. So friction is actually the brakes that stops one

surface from moving. So it's what's actually stopping the patient from sliding out of the chair from like a slip and slide. So friction in itself is not a bad thing. But when you cannot move yourself or gravity kind of takes control, friction can be detrimental to the skin and tissue if we allow the stress and strain to occur over and over. Okay? So, shear happens when a client is in movement, unlike pressure that can happen when a client is just sitting here. I could just be sitting here still, and that constant compression from pressure could be happening. But shear takes effect once I've started to go into movement. And so if you look at this little, what I love to call my Blue Man Group, shear usually happens when a client slides into an unwanted posture. It can also happen during functional movement as well. So when we're reaching or repositioning, shear is happening as well, okay?

So in this example of unwanted movement, a lot of times what happens is, we'll place a resident into a chair, and we use these old wheelchair models that are fixed at 90 degrees, and we try to force someone to sit at that 90, 90, 90, that was a very old school thought of how we should be positioned our patients. But what's wrong with that is that a lot of our elderly clients either can't even get to 90 degrees because of some type of range of motion limitation, or they can't tolerate it for long periods of time. So if we try to force them into this posture, they are going to slide like in the second picture into one of the abnormal postures. And as they start to slide, the pelvis will go into either a pelvic obliquity or posterior pelvic tilt, etc. And in this example, you can see a sliding into a posterior pelvic tilt, you can actually see the pelvis going from a neutral down into a posterior pelvic tilt, where we'll now start sitting right on the sacrum and the coccyx. And what happens is as that bony prominence in the skeleton starts to move, cushions and back supports don't want our clients sliding out, right?

So they're made, the covers of the cushion in the back support are made with a high coefficient of friction, that are, as I said, are those brakes. That's what's going to grip the skin and the tissue to stop that patient from sliding out. But take it a little further.

We now have that downward pressure from gravity. The patient starts to slide, but the cushion cover is actually grabbing the skin and the soft tissue. So in this picture, you can see this thin layer right here is the epidermis, this is the dermis, this is the hypodermis, and this is the muscle tissue. As I said, the skeletal system that's inside of the skin, which I sometimes call like the sack, is going to continue moving whether we're reaching or we're sliding, but the cushion cover is going to grab that skin and soft tissue. So you have the bone still continuing its path of movement, the skin and the soft tissue are grasped by the cushion cover, and right here at the bone muscle interface is where the shear stress and strain are happening. And you see the cellular distortion and the tearing of blood capillaries, and we start to see permanent cell structure damage that leads to a pressure injury. So I know that shear can be a very difficult topic to understand. And in a nutshell, what you need to understand is that the pelvis and the spine will move, while the skin and the soft tissue gets stuck to the cushion and/or back support surface. And the oppositional forces then damage that stuck soft tissue resulting in the wound. Okay?

All right, moving on to the extrinsic factor that's much easier to understand; microclimate. And again, I think this is one of the extrinsic factors that we probably know a little bit more about and understand. And we know that it is a buildup of excess heat and/or moisture at the seat surface. And that excess fluid, what happens is it actually removes the natural oils that we have in our skin, kind of like a Labrador Retriever, right? That helps to lubricate our skin and create a waterproof barrier. And when that waterproof barrier is lost, it can be easily over hydrated, increasing our skin susceptibility to laceration. And where does that overhydration come from? It can come from urinary or bow incontinence. So think about that statistic we talked about on the first slide. It can come from excessive sweat, it can come from drainage from an existing wound. And this really leads as I said to maceration. And maceration by definition is the softening and the breaking of the skin, resulting from prolonged exposure to moisture. What we need to understand it and most of us don't is that the

effects of pressure and shear are actually increased when microclimate is present. So not only is microclimate detrimental to itself, it actually increases the effects of both shear and pressure. Okay. So why are we dedicating an entire course to really understand what is going on with the natural age related skin changes, that make this elderly client that we're dealing with so susceptible to pressure injury development? And because simply, it's the largest organ that covers our entire body, and it has very, very critical function in protection. And the skin is what directly touches all the support surfaces of the wheelchair, and really acts as a barrier of the deeper structures such as the organs or soft tissue and skeleton from that stress and strain and trauma. It also has a very important role in thermal regulation. So it helps protect us from excess heat or cold, it helps us to sense pain, pressure, detect deep touch, etc. so that we can again be protecting ourselves from those extrinsic factors. And we as therapists have to recognize how the skin can be damaged if we wanna make the appropriate choices.

So we're gonna have to study how healthy skin functions in order to understand the changes that they go through that make our elderly client more susceptible. So the skin is made up of three layers, and most of you probably know this. That first outermost layer is the epidermis, and that's what we can touch and see. That second thickest middle layer is called our dermis, and then that deepest layer is the hypodermis, which is also known as the deeper subcutaneous layer. Now, what we're gonna do is we're gonna take a deeper look at each of those layers and really understand their function and how when healthy, can protect us against pressure sheared microclimate. So the most superficial layer, as I said, is called the epidermis, and it's the first line of defense that we have against any type of environmental factors. So the epidermis has a very thin oily coat that prevents pathogens such as bacteria and viruses, that could possibly cause an infection from entering our skin. And that oily coat also acts as that waterproof barrier to prevent the entry of harmful external fluid while locking in moisture that we need to stay hydrated, so that our skin doesn't become brittle and dry and easier to break open. The epidermis also houses the

longerhans cells. And I always joke because I feel like I sound so intelligent when I say longerhans cells. But anyway, these cells have a huge role in immune function. And they act as that initial warning sign. They really alert the patient themselves or maybe the caregiver. Because what it does is it changes the temperature of the skin, it causes the skin to become red or hot to touch, so that you know that, uh-uh, hey, something's going on here; either I need to take away the pressure or figure out how to stop this attack against my body. But allows you to know that something's happening. And the epidermis also plays a very critical role in wound healing and the maintenance of healthy skin, because it's continuously shedding. Its shedding away the dead damaged skin cells and replacing it with new, healthier cells when an injury occurs. And then lastly, the epidermis is known for that function of synthesizing vitamin D. That is extremely important when we're talking about the elderly client because it prevents bone density loss, fractures, osteoporosis, and this is just another great reason why we need to get them seated in a great seating system that they can be up as many hours of the day they need to, get out and get themselves some sun, right?

All right, the next thing we're gonna talk about is really the dermal-epidermal junction. And this is where the thickest second layer of the dermis is connecting and talking to the epidermis, okay? And this junction plays a critical role in the healing of skin, especially after injury. And the junction has these wavy finger like projections that you can see, and they really interlock the dermis to this epidermal layer, and they enable blood flow from the dermis to the epidermis to allow for an exchange of oxygen and nutrients to take place to promote that cell turnover rate. Okay? The nutrient and the oxygen exchange play that critical role in healing and injury when it happens, because now it can shut off the dead skin cells and replace it with healthier ones. And that constant cell turnover allows us to maintain the thickness of both layers to really act as the barrier and minimize the risk from future trauma. The dermis is that middle layer accounting for up to 90% of our skins thickness, and is most responsible for protecting our bodies against physical stress and strain. And it's made up of a ton of

components, and each of them playing a very important role in maintaining the health of the skin as well. And I'm gonna kind of go over that quickly for you.

So the first component of the dermis is the fibroblast cells. And fibroblast cells produce the cells proteins, which are collagen and elastin. And they together help prevent injury from especially trauma or stress and strain, and really assist in repairing skin after the injury as well. So the collagen is what supplies the skin with its strength and its form, right? It provides that tensile strength. And tensile strength refers to how much actual tension, how much pressure can be pushed onto the skin, and how much the skin can withstand that pressure before it breaks open. So the collagen is super important. And when we lose collagen, the skin loses its firmness and its strength. And that's why we kind of see our skin starts to sag and we get that Turkey neck as we age. And then the second protein is the elastin. And the elastin provides a skin it's elasticity. And that's you know, the playability of the skin to really stretch when pressure is applied and then returned to its original shape when the pressure is then removed. So the skin will stay intact and the integrity is there.

So the collagen and elastin, if you can kind of see my little waffle fries up here, they are neatly interwoven, and they're very well organized. And they have a specific pattern, so that it can maintain the strength and maintain both that tensile strength and the elasticity to keep the skin's firmness and integrity. The next property that the dermis has built in is the viscous elasticity. And this really takes into account our skin's natural water content. If you remember the epidermis layer, one of the biggest things that it does is it locks in needed fluid that we need. And that's where our skin gets its water content. And if you think about it, it makes a lot of sense because this water content in connection with the elastin fibers, allow the skin to kind of stretch beyond just the capabilities of the elastin itself, for additional movement of the cells in the soft tissue, beyond the capability of those elastic fibers alone, which really should make a lot of sense to you, because think about stretching, right? I have calf muscles and type

achilles tendon, and I go to stretch on dry land, it feels like maybe sometimes my achilles is gonna snap. But if I get into water, I can actually stretch beyond the capability of what I can do on dry land and I can get further and it doesn't hurt as much and I really don't feel like I'm at as much risk to pop that Achilles tendon. Okay? All right. Another key component of the dermis are the blood vessels. And the epidermis, very important to understand that outermost layer has absolutely no vascularization. It receives its blood supply and oxygenation solely from the deeper dermal layer. And the blood vessels found in that dermal layer are what transport oxygen rich blood and nutrients to the skin at both those layers, to maintain the skin health and help heal an existing wound. 'Cause we know, What does it wound need to heal? Oxygen and nutrients. So the blood vessels also carry away waste products to really prevent any type of infection. And then lastly, a key point about the blood vessels is they play an important role in temperature regulation.

So thinking about that microclimate again. And when our bodies exposed to extreme temperatures of heat, those blood vessels are gonna relax or vasodilate allowing for the blood vessels to really release the heat in order to lower body temperature again. And then on the other hand, when we're exposed to extreme cold temperatures, it does the exact opposite; the blood vessels contract or vasoconstrict, helping us to be able to retain that heat and maintain internal body temperature. Okay? The other thing that is housed within the dermis is that you have the lymphatic system there. And this really is the lymphatic system really fights off infection, and it transports lymph throughout the lymphatic vessels found in the dermis. And lymph is a fluid containing white blood cells. And as an infection occurs, those white blood cells are gonna elevate tremendously as we're exposed to the infection. And what they do is they pick up toxins, they carry them to the filtering stations, which are lymph nodes, so like under the armpits and the groins, etc. They excrete the toxins that we don't need through our urine and our feces, and then reabsorb anything that the body does need and dumps it back into the bloodstream. So if our skin is damaged, the lymphatic

system will be compromised and leave us a little bit more vulnerable to maybe potentially life threatening infections. We also have nerve fibers in the dermis that allow us to feel, sense temperature, sense cold, pressure, pain. And these nerve fibers when healthy are very sensitive and pick up very quickly the sensation to kind of alert us and wake us up to move out of position that might be causing pain or discomfort, and potentially could harm the skin.

The dermis also houses both sebaceous and sweat glands. And the sebaceous glands again produce that sebum, which is oil that travels up, and I'll show you right here. So this is the oil glands produces the sebum, and then it travels up these ducts and excretes it on to the epidermis, that provides that oily barrier that we've been talking about. Again, it prevents the excess fluid from entering and it also locks in the fluid that we need. As well we have those sweat glands which are my little green squiggly lines. And when microclimate is present and the body temperature rises, what happens is the sweat glands produce sweat, it again travels up the ducts, is released onto the epidermis and then evaporated to cool the surface of the skin, lowering the body temperature once again. So, the sweat glands also can help and excrete toxins through the pores back up into the environment, getting rid of whatever body just doesn't need. So really important in microclimate, these two glands.

And then we have the deepest layer, which is our hypodermis. And this actually makes up for 15 to 25% of our body weight. And why is that? Simply because it's made up a whole lot of fats. It's also contains, as well as fat cells, connective tissue with deeper blood vessels, more lymphatic vessels, and also some more nerve endings. And fat cells do play a critical, critical role in insulation, working a lot like the insulation that we have in the walls of our homes, to really prevent heat loss and regulate the temperatures of cold. And so they also that fat layer really acts as a shock absorber, preventing damage to the skeleton and the internal organs and the deeper, deeper tissues from the pressure and the trauma and the stress and the strain that we can

sustain sometimes from the outside environment. The connective tissue of the hypodermis really anchors our skin to deep fascia surrounding the muscles in the bone, and really allows everything to kind of glide smoothly together during movement. And the hypodermis, as I said, it also contains those blood vessels and lymphatic vessels that again help transport oxygen rich blood and nutrients, and then the lymph to and from the dermis. So, I think it's really important to understand the layers of the skin and their function. And hopefully now, it's gonna be glaringly apparent that the skin has much more complex function than just being the outer shell of our body, right? And each layer when healthy has a critical, critical role in maintaining overall skin health to help fight against those extrinsic factors.

So, what happens is that unfortunately, our skin changes with age, and/or the result of a disease process, 'cause they remembered comorbidities actually increases the rate of the skin changes. And that really makes our elderly client much more susceptible to those extrinsic factors. So what I'm gonna do for you now is we're gonna be comparing young healthy skin, which is pretty much what we just talked about, to age disease skin that we would see probably in our elderly clientele. And we'll be able to see how the extrinsic factors can damage the skin more easily. And it's gonna become more clear that we as therapists really do play an essential role in finding the appropriate equipment with built in skin protection properties, to really protect our clients from developing a pressure injury. So let's look at some of these age related changes in relation to that outermost layer, the epidermis. And the most important thing to understand is that our skin just thins. And unfortunately, the epidermal layer thins by 6.4% with each decade of life. So that means that our skin is much thinner in our 80s than it was in our 20s. Whether we like it or not, that's that's how it goes, right? And cell turnover rate is significantly decreased as well. So dead, damaged skin cells take longer to shut off and be replaced with healthier skin cells, causing an increased wound healing time among the elderly. And cell turnover rate is 30 to 50% slower in our 80s than it was in our 30s. So this is really going to increase wound healing. As well

at that epidermis layer, we have a decrease in those langerhans cells. That are again, that first indicator causing the reddening or the temperature change of the skin to warn us that something's going on. And so when that warning capability of our skin is diminished, it's gonna take the elderly client a lot longer to be aware that injury is even occurring. As well, when we start talking about kind of the dermal epidermal junction, the junction itself that used to be healthy and has these finger-like projections kind of flattens out. And it's pretty much like I said, flatlining, and we know that anything flatlining is not good. And there is a significant reduction in the amount of blood flow and oxygen and nutrients being delivered to both layers of the skin, which are gonna again, thin both layers. And as well, you're gonna see decrease vascularization. So that decrease vascularization is what is then, you know, besides the junction flattening out, now we have fewer and thinner blood vessels that just can't transport the oxygen and the nutrients.

So once again, we're gonna have to thinning out of both layers now, we're gonna have less barrier of protection, and we're also gonna have skin that's gonna take longer to heal. At the dermal layer, the number of sweat glands and sebaceous glands are significantly reduced. And a decrease in the number of sweat glands produced and secreted when the body temperature rises, prevents that evaporation and the ability of our body to cool down the surface temperature of our skin. And then when the number of sebaceous glands is reduced, there's less sebum, which is the oil, so there's a less waterproof barrier. And the lack of lubrication really causes the skin to become drier and more brittle and much easier to crack open. So we know that, we see that in our elderly population; their skin is very dry, and they could just touch something that they rub against and their skin breaks open. And then again, unfortunately, that water repellent benefit that the sebum provides for us to fight off excess moisture from entering the skin is also lost. So if you're dealing with a patient that has excess moisture, especially due to urinary incontinence, it's going to macerate the skin much

more easy. The epidermal layer will be taken away. And then the deeper layers of the skin are more susceptible to the extrinsic factors among our elderly patients.

Okay, the dermis as well. We talked about those fibroblast cells, you know, especially the proteins of collagen and elastin. And I kind of discussed with you how they kind of look like a waffle fry. They're interwoven, and they're very well organized. Well as we age, they just become less than number., and they are not organized. So instead of being strong as a unit, they're kind of sporadic and fewer a number and just not organized at all. So what happens is our skin loses its tensile strength and its elasticity. So as pressure is applied, the skin, it can't sustain as much downward pressure and it can't deform and then come back to its original shape when the pressure sources removed, because that elasticity and the tensile strength is gone. So when pressures applied, it's very Much easier to break open. The dermis also thins unfortunately because of that loss of oxygen and nutrient supply. So there again is a significant reduction in the protection to the deeper layers of our skeleton and our organs and deeper tissues, because the barrier between the bone and the pressure source is reduced significantly. And then as well there's fewer elastin fibers being produced and a loss of that skins water content. That waterproof barrier is gone. We're not locking in the moisture that's needed. With aging skin, so you're going to see a decrease in that skins capability to deform and return back to its shape beyond the capacity of the last one, because there's not as much water.

So then with sustained pressure and sheer, permanent distortion and cell deformation is gonna occur, tissue death will happen at the deeper layers of the soft tissue, so it's really detrimental. As well at the dermal layer, the nerve endings just lose their effectiveness, right? So, it takes longer for our clients to process painful stimuli. It doesn't mean that they won't feel it. You know, that might happen, but it takes longer for them to even recognize that something's going on. So what happens is it takes longer for them to process pain or pressure or temperature changes, so then their

reaction time decreases as well. So, an elderly client is gonna take a lot longer to feel pain. And whereas a young person might shift off of that painful stimuli in five minutes, it might take the elderly client an hour, maybe two hours to feel that same sensation. So they're going to be at risk for a lot more prolonged sitting in one position that can do some damage versus a young, healthy adult. And the deepest layer of our skin, we again, see a decrease in that thickness, everything kind of decreases, but it's different. Since this layer is made up of mostly fat cells, we never lose fat cells as we get older. They may kind of thin out. But what they really do is they redistribute to another area, the skin have a greater surface area. So it goes from a small surface area of right under the ITs or under the sacrum and under the coccyx, and it naturally redistributes to greater surface area of the thighs or at the stomach.

So again, there's a lot less barrier under that bony prominence and the support surface than there was in a young healthy adult. As well, we lose that insulation and that thermo regulation capability of the skin. So we just can't dissipate heat like we did in the past and, the effects of microclimate will be greater in an elderly patient. There is also a decrease in the connective tissue that anchors the skin and the soft tissue and the muscle to each other and to the bone. So, the skin is now less firm, it loses its shape, and it becomes weaker. And it's makes the skin more susceptible again to that prolong pressure under those bony prominences. Alright, so now that we've discussed what is changing at each layer, we're going to now take a look at each extrinsic factor and see how that specific factor is going to be more susceptible and damaged with these changes.

So, why is the elderly client more susceptible to just pressure alone? And each layer of the skin as I mentioned faints and it weakens. And weaker skin breaks open more easily, you know, end of story. So there is a reduction in the barrier between the pressure source coming from the support surface and pushing down from gravity, and the client leaving everything in between like the skin and the soft tissue and blood

vessels and lymphatic vessels and muscle much more susceptible to damage with that constant prolonged pressure. Prolonged sitting in an abnormal posture, you know increases the risk of ischemia and tissue death. Now, especially because we have a loss of those Langerhans cells. Again, our body just is not responding as quickly and we don't see it as fast. And as well, we have decreased sensitivity due to the nerve endings being impaired. So it takes longer for our elderly patient to pick up on the pressure, and it definitely takes longer for them to process it and do something about it. So blood supply is gonna be cut off for longer periods of time from constant downward pressure, causing ischemia and cell tissue death. As well, we have again, the reduced collagen and elastin. So, as someone has more constant pressure coming down, because it's lost its strength its elasticity, it's gonna take a lot less downward force to break open that skin. Then, in the hypodermis, we just don't have as much of a barrier; those fat cells redistributed away, and that downward pressure just doesn't have as much cushion and is gonna break open that skin right under that bony prominence much easier.

So, the problem with all of that is that then we have the issue on top of it, that we don't have the same blood flow, we don't have the same vascularization, and we don't have the oxygen and the nutrient exchange to actually heal those wounds once the injury has happened from prolonged pressure. All right, so talking about how shear; we have an increased susceptibility to shear when we're older. And remember that shear happens when a body is in movement. And that the friction are those brakes being applied to the skin trying to stop someone from just sliding right out of their chair like a slip and slide. So the friction causes a sticking, you know, or grasping or gripping of the skin in the soft tissue to whatever support surface it's on, while the bony landmark inside of the skin continues its path of movement. So what that does is actually deforms the cell structure, it tears blood capillaries and it creates a wound. And it is now understood that a wound caused by the deformation and distortion and the ripping of the blood capillaries is actually way worse and happens way faster than just

from ischemia of downward pressure. So it's really scary, and that is why we really need to understand shear.

So, the skin changes. That again make the elderly client more susceptible to shear are again, thinner skin, less vascularization, so the blood cells are now more fragile. It's much easier to tear a fragile blood vessel with shear, stress and strain. As well because of the disorganization of that loss of collagen and allow fibers, the cellular strength itself is not as strong. So, when the shear, stress and strain are applied, the cellular wall is going to be distorted much further and it's not going to be able to come back. And then the elastin fibers again in the water content are diminished. So, the skin can no longer have that capability to kind of give more due to the water content. And again that stress and strain from shear are going to permanently deformed cell and distort the cell structure, and there will be tissue deaths leading to skin breakdown. And then in that hypodermis since the fibers bands that connect the tissue that really anchor the skin to the deeper tissue is lost, once again the firm is just not as firm and resilient in the deepest layers. So when that frictional force plies the break and the bone continues to be in movement, again, the distortion of the of the deep tissue and the tearing of the deep blood capillaries causes a deep tissue injury. And then again, not as much oxygenation, nutrient exchange a longer healing time when it does occur.

So, more susceptibility to microclimate; of course, the elderly skin is losing all of its great properties, like the sebum production that causes the waterproof barrier, you lose the sweat glands, so you know, lower the body temperature, you have the impaired nerve endings, so you just can't even detect the temperature change. And so again, the skin will be much more susceptible to an increase in temperature. And the problem when the body temperature raises is naturally going back to your anatomy and physiology days. As body temperature raises, it raises your metabolic rate as well. And we all know that when metabolic rate is increased, what does it demand of us more? Oxygen. So we need more oxygen to be delivered to the tissues in order for

them to stay healthy and viable. But, we don't have the oxygenation because the vascularization in an elderly client is diminished. So now thinking back at maybe our economic days of studying economics in school, this is a situation of supply and demand. We have a high demand for oxygen, but a low supply. And so, the cells are gonna be affected more rapidly because it needs more oxygen, but it doesn't have it and it's going to be easier broken down and distorted into fat. And then at the hypodermis, you know, we have again, that loss of that insulation barrier, that decreases the thermal relationship capacity. So again, our body is going to produce and reabsorb more heat, and is going to increase the microclimate there at that seat surface. All right.

So once injury has occurred, it is really important for us to understand the stages of pressure injury, so that we can understand what stage is my client at and what would be the best intervention for me to provide in regards to the wheelchair configuration and equipment. And the first thing I think that we should be familiar with is what are the common areas of skin breakdown? That will help us when we're performing our screens and our initial evaluations to really hone in on specific red flag areas, to really inspect the skin at these hot areas to devise the most appropriate intervention, right? So if I know that my patient is sitting in an obliquity, and I know that means that they're sitting on one of their ITs more than the other, that it is really pushing down into my seat surface. When I do my screen, I'm gonna look at that area and really see, is this an area that is of concern and I need to do something about? And so, the common areas of skin breakdown in the seated posture are up here on the screen, and they're kind of the hotspots, and they really are of the sacrum, the coccyx, the ITs, possibly, like I said the greater trochanters; if someone's sitting in a chair that's very narrow for them or they're sitting kind of cockeyed and they're kind of pushing against one of the areas, the scapula for sure, the spinous process, sometimes on the rib cage, definitely at the elbows, against the the arm rests, behind the head if you're using a head support and at the heels if you're not supporting them correctly on the foot plates. So once we've

picked up the client for the seating referral, you know, we've identified the at risk areas of the skin that may be reddened. The next step is to decide if that skin is already experienced tissue damage, or is maybe the reddening only an indication that this is a high risk patient but tissue damage just hasn't occurred yet? And we do this by performing the fingertip test to see if the skin is blanchable versus nonblanchable. And the fingertip test is performed by, first and foremost gloving up, especially today. And glove up, press the fingertip of one of your fingers into the skin that is reddened, you hold that for three seconds, then you remove the pressure. And if there is no color change and the redness persists, then you know that that skin is termed nonblanchable. So that would be over here on the right hand side of the screen. If when you remove that pressure, you notice that that reddened area has turned white, and you can see that right here on the screen, then the skin is termed blanchable.

You know, we're probably asking, why do I care? Why do I care if it's blanchable vs non-blanchable? And when the skin is blanchable, that indicates that there is pressure entering the body at the site that makes the client high risk, but no tissue damage has occurred just yet. So that's a good thing, right? So this cues us that we're dealing with someone that I need to do something for to try to prevent or minimize the risk of a pressure injury occurring, but thank goodness no tissue damage has occurred just yet. And that through those equipment choices, we can kind of maybe quickly reverse the adverse effects. However, if you perform the fingertip test and the redness does persist, then we know that the tissue damage has already occurred. And this means to us it kind of translates and says; I need to be a whole lot more aggressive with my intervention, really look at what type of product I'm putting under them, needs to have definitely skin protection properties built in and definitely need to look at probably what's the configuration of their wheelchair is.

So, this is gonna be different in darkly pigmented skin. So, darkly pigmented skin can happen for a couple of reasons. You know, sun exposure, definitely gender, race,

hormones or even just age. And if we try to perform that fingertip test, the skin probably will not blanch, okay? So how do we then test for someone who has darkly pigmented skin? And these are some other indications that tissue damage is probably going on. So you wanna inspect the skin in question for discoloration compared to the skin around it. That would be an indication. Sometimes is moist in the skin, which sometimes can help really amplify a color change a little bit better. If you're dealing with someone who's cognitively intact, ask them, just simply ask them, "Do you have pain in the area of question." And then feel for induration of the skin. And that is localized hardening of soft tissue. So damaged tissue becomes firm, but it is important to know it's not quite as hard as the bone but it is more firm in comparison to the skin around it. Okay? So stage one injury is non-blanchable redness or any of the other indications in darkly pigmented skin that we just talked about, okay? It is skin that has not broken open and the redness is bright red. It is not a deep red, it is not purple or maroon. If you see one of those colors, then it's actually an indication of a deep tissue injury rather than a stage one pressure injury.

Stage two, and remember this is that 50% of our nursing home residents have a stage two pressure injury. What happens with this is that the entire epidermal, that outermost layer is gone. And it has now gone into the second layer of our skin. So this is an open wound. 50% of our nursing home residents now have an open wound. The wound bed is usually a nice pink or red color. It might have a serum filled blister, and that's important to know that it's serum filled, it is not blood filled blister. If it were a blood filled blister, that means that there was damage to the blood vessels and that would be a deep tissue injury versus a stage two. The hypodermis, the muscle, the tendons, the ligaments, the bone are all intact. It's just going into the second layer of the skin. And the NPIAP actually talks about why a stage two happens, and they usually tell us it's coming from adverse effects of microclimate and shear of the skin over the pelvis. So that's really important for us to understand, because that's cueing us as therapists to understand that; we not only have to buy products that boast about being able to fight

against pressure, but we need to look at something that has an effective fight against shear and microclimate.

The stage three wound now enters into your hypodermis layer. So the entire epidermis, the entire dermis, and now is going into your hypodermis, that yellow fatty layer of skin. Still haven't affected the muscle, tendons, ligaments or bone. And there is maybe a scar or... I just drew blank. Anyway, there might be in the wound bed some scar, and it might be partly covering it but will not cover the entire wound. And so there could be undermining and also tunneling. And undermining means that the wound is actually spreading out wide, and tunneling means that the wound is going deep. And in areas where you have a lot of tissue, so, like maybe on your glutes, you might see a pretty darn deep wound. Okay?

All right, the stage four, and this is kind of where a lot of nursing home facilities are getting dinged, because we will get a lot of trouble by state surveyors if we allow a stage four to happen in our facilities, or you've allowed a stage two or stage three to really progress to this very advanced stage. And a stage four is called a full thickness skin and tissue loss, because now, we have exposure of the tendon and the muscles and the ligaments in the bones. So we've gone through all layers of skin, all the way down to the bone. Slough and eschar, that's the word I couldn't remember a second ago, could be present as well. But again, it's not gonna cover your entire wound bed. And undermining and tunneling could happen as well. So these could be very large pressure injuries.

And then probably another very commonly seen wound is called the unstageable pressure injury. And I used to get a ton of referrals for this come across my desk, and I would have a doctor right and this would truly be my referral. Referral for OT, due to an unstageable wound, needs a new cushion, exactly what it would say. And, you know, when I first started, I was like, well, what the heck does that mean? What's an

unstageable wound? And that's why it's important for us to know these classifications, because an unstageable wound, you know, does that mean it's a wound that's not so severe, is it very severe, and you it is important for us to know what it is, so we know what we're looking for in terms of our intervention. And so what that means is that Escobar and slough are covering the entire wound bed. But, what the NPIAP says is that, once the wound care specialists removes the slough NASCAR, always a stage three or stage four wound will be shown. So when you have an unstageable wound, you're talking about at a very advanced wound. So you can't just go get an entry level cushion for this individual, you need to get a skin protection cushion that was built to stand up against some of the nastiest looking pressure injuries that you might see. All right, then the dreaded deep tissue injury. And this is a scary wound. Why? Because you don't know what's happening until it's too late.

So again, the NPIAP, and just for some of you who wonder why I'm saying NPIAP versus NPUAP, they actually just in the 2019 clinical practice guidelines that came out, they changed their name from NPUAP to NPIAP. So they are now the National Pressure Injury Advisory Panel. So just so you know that's why I keep saying that. You know, they do talk about what's at risk. And they do say that with this deep tissue injury, probably the first sign that you're gonna know that something's going on is pain. Just somebody, you know, verbally telling you they're in pain or in a non verbal patient, they might have more behavioral episodes; they might be crying out more, they might be trying to get out of their chair more, they might be reaching for you more, they might have more behavioral things, but pain is probably the first indication of deep tissue injury. And they do say that when you have a patient that is complaining of pain, you should be doing something in terms of skin protection, through the mattress choices, through the cushion, support surfaces. And so that's important for us to know.

And what happens with a deep tissue injury, it's not like the wounds that were used to that happen and start here at the epidermal layer and go deep, they actually start

because of shear at the muscle and bone interface. And again as that bone is going into movement, but that skin in soft tissue or being grasped by the seat surface or the mattress surface, there is that issue of you know, the bone going in his path of movement, the skin staying and you have that stress and strain coming on by shear. So the actual injury starts here and works its way upward towards the surface of the skin. And I always call this the silent kind of extrinsic factors shear because it doesn't show us any signs, the patient might just say they have pain. And once it does show us something at the epidermal layer, it's too late and the injury has gone through all layers of the skin. So you might see again, a purple, a maroon discoloration, it's not gonna be red, it could be open or it could be closed. And again, it might have a temperature change once it gets all the way up here, but the number one way to know that something's going on is a report of pain.

All right, so wrapping up the course, I think that you know, it's important that we know the role of us as therapists in regards to wound care. And number one, we just need to start performing more screens and asking the right questions. Instead of asking has your patient had a decrease in their ability to feed themselves or dress themselves for walk, we do need to start looking at wound care as part of the screening process. Ask questions like are they sitting in an abnormal posture that it would increase the risk of a susceptibility for skin breakdown? Look at them, see if they're sitting like this, right? Ask if they have pain in sitting, ask if they are demonstrating increased behavioral outbursts when the CNAs or the nurses placed them in their wheelchair. That might be an indication of discomfort or a pressure injury. So, identify then, the abnormal posture that they're sitting in so that you can recognize what area you should be looking for within the common areas of wound development. And then understand the age related changes that really make that elderly patient more susceptible, and understand the pressure injury stage that they are in, so that you know exactly what you should be trying to do in terms of how aggressive with the skin protection equipment you might be looking for.

Next, pick them up for a seating and positioning evaluation with the goal to choose the appropriate wheelchair model that can be configured to minimize sliding into one of those abnormal postures. Choose the appropriate skin protection cushion that doesn't just fight pressure, 'cause now we know that shear and microclimate are just as detrimental. Also choose a back support that's gonna help create even pressure distribution, and help stay Realize the pelvis and the spine to prevent unwanted movement. And then you know, if you have to add any needed accessories to maintain that optimal stabilization alignment, then go for it. And by providing optimal stabilization and alignment through the correct equipment choices, then we will be able to protect our clients that have compromised skin against those extrinsic factors. So, that wraps up the course. I thank you guys for attending. And now I'm gonna hand it back over to Fawn for questions and answers.

- [Fawn] Hi, Ana, thank you. Here are a few questions coming in. If there are one or two pieces of advice we could give to our elderly patients that already have skin breakdown, to direct them in healing, what would those be?

- [Ana] Two piece of advice to give to the patient themselves. Is that correct?

- [Fawn] Yes.

- [Ana] Okay. I would honestly tell them if obviously they would be a cognitive patient, I would tell them. Every time, if you're watching TV, for example, every single solitary time a commercial comes on, you need to move, you know, you need to shift off of one area onto another area. Nowadays, everyone has some type of like a watch that has an alarm on it, set that for them, that you know, it comes off with every 15 minutes and they move. You know, help them to be more successful by giving them some tools. If by any chance you do have power wheelchair users, there are a lot of things out there

like virtual seating coaches, that you as the therapist can actually set those kind of things up for them. The other thing that I would say to them is listen to your body. If you don't feel right, you know, move, move off of it or tell somebody immediately, because we can sense those sensations right away. If they feel even the littlest of thing they need to listen to their body. So if you don't feel right, move. And definitely just think about the kind of clothes that they're wearing. I know that a lot of our elderly clients love those old kind of like disco outfits of polyester, really recommend for them to start wearing very breathable kind of cotton outfits, things that would help with that microclimate.

- [Fawn] Another question coming in; is a row cushion the best option to address too much pressure or a Tilton space wheelchair?

- [Ana] Okay. So, there are a lot of cushions on the market that do very different things. So a row has an immersion and envelopment cushion. It is a phenomenal cushion, obviously for pressure management. Do I believe it's the only cushion out there for every patient? Absolutely not. I had a really good friend tell me one time, there's a cushion for everybody and a butt and a butt for every cushion. And so, with a row, again, you're going to get amazing pressure relief and pressure distribution. The neoprene that it's actually made of, actually has a lot of shear reducing components to it. But there are some other air options on the market; vicarious another, I think, fantastic air option. But the other thing is too, you really have to understand your client. Maybe an immersion envelopment cushion is not what they need, maybe they need more of an offloading cushion that's really going to take that at risk area and completely or partially offload that to reduce the risk. So that's what I would say about that. And I didn't remember the second part of the question. I'm sorry.

- [Fawn] I think they were just asking about tilting sit. I think you're just wondering about tilting, or if that was a good idea or not.

- [Ana] Oh, absolutely. Tilt is actually one of the... The Resna has a lot of papers out about that, and yes, tilt is definitely a way to take away you know, pressure from a hot area. If you are able to do a tilt in space chair, 100% would recommend it.

- [Fawn] Alright, great. I think we're going to close the classroom for today. Thank you so much, Ana for a great talk today. And thanks for all the great questions that came in. I hope everyone has a great rest of the day, you join us again on continued in [occupationaltherapy.com](http://occupationaltherapy.com). Thank you.

- [Anna] Thank you.