ProCare Training Manual
Chapter 1
The Fundamentals of Wound Care
Structure of the Skin

As you probably already know, your skin is the largest organ in the body. It accounts for about 6 to 8 lbs. of a person's body weight and has a surface area of more than 20 square feet. The thickest skin is located on the hands and on the soles of the feet; the thinnest is around the eyes and over the tympanic membranes in the ears.

Skin is made up of distinct layers that function as a single unit. The outermost layers, which are actually a layer of dead cells, migrate to the surface and are completely replaced every 4 to 6 weeks. The living cells in the skin receive oxygen and nutrients through an extensive network of small blood vessels. Every square inch of the skin contains more than 15' of blood vessels.

Skin protects the body by acting as a shield between internal structures and the external world. Skin also influences how we feel about ourselves. When your skin is healthy and unblemished with good tone and color you feel better about yourself. Skin also reflects the general physical health of the body.

Any damage to the skin is considered a wound. Wounds can result from events such as surgery, accidents, such a fall, exposure to the sun from UV rays, abrasions, friction, traumas and, of course, pressure.

Layers of the Skin

Skin has two main layers; the epidermis and the dermis. A layer of subcutaneous fatty connective tissue, called the hypodermis, lies beneath these layers. Within the epidermis and dermis there are five structural networks they are:

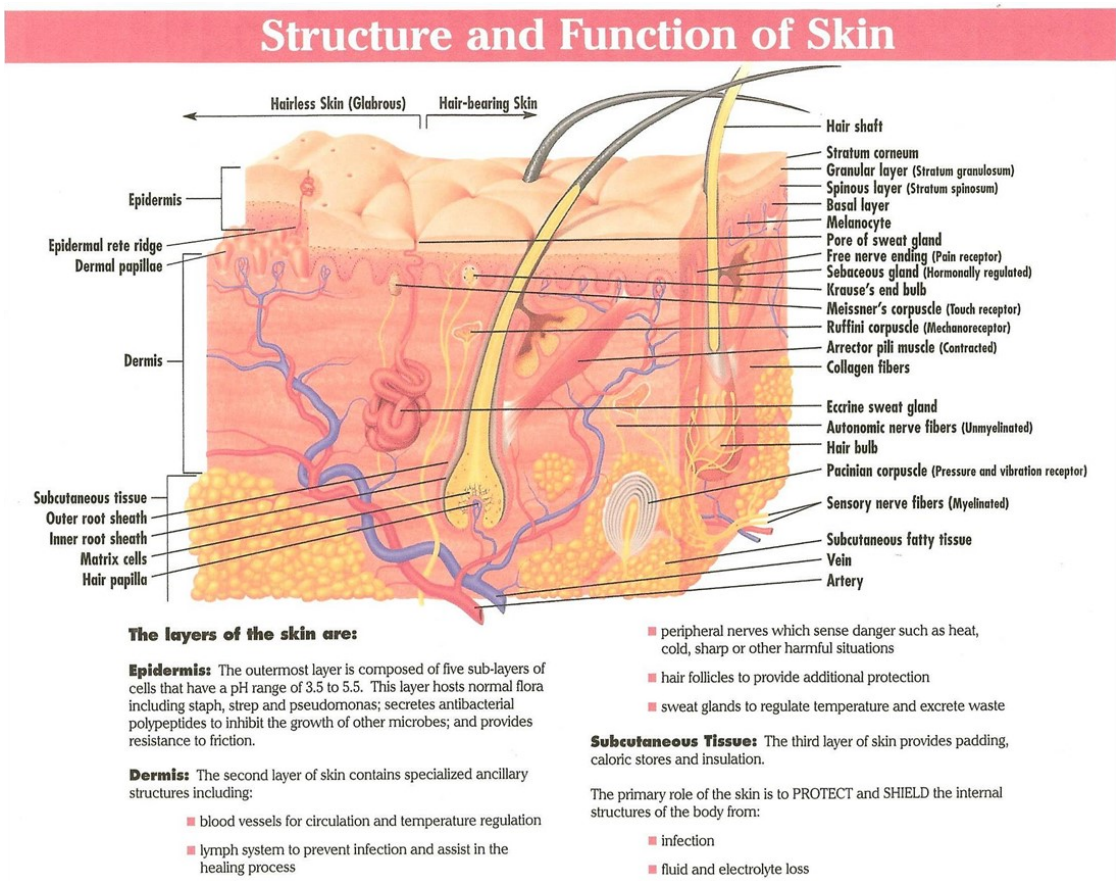
- Collagen fibers
- Small blood vessels
- Elastic fibers
- Nerve fibrils
- Lymphatics

These networks are stabilized by hair and sweat gland ducts. Figure 1-A shows all the components of the skin.

Figure 1-A Structures and Function of skin layers

Epidermis

The epidermis is the outermost of the skin's two main layers. It varies in thickness from area to area. The epidermis is slightly acidic, with an average pH of 5.5. Covering the epidermis is the keratinized epithelium, a layer of cells that migrate up from the underlying dermis and die upon reaching the surface. These cells are continuously generated and replaced. The epidermis also contains the melanocytes (cells that produce the brown pigment melanin). These cells give skin and hair its color. The more melanin produced the darker the skin produced. Skin color can also vary from area to area on the body. Melanin production is regulated by the hypothalamus, which produces a melanocyte-stimulating hormone.

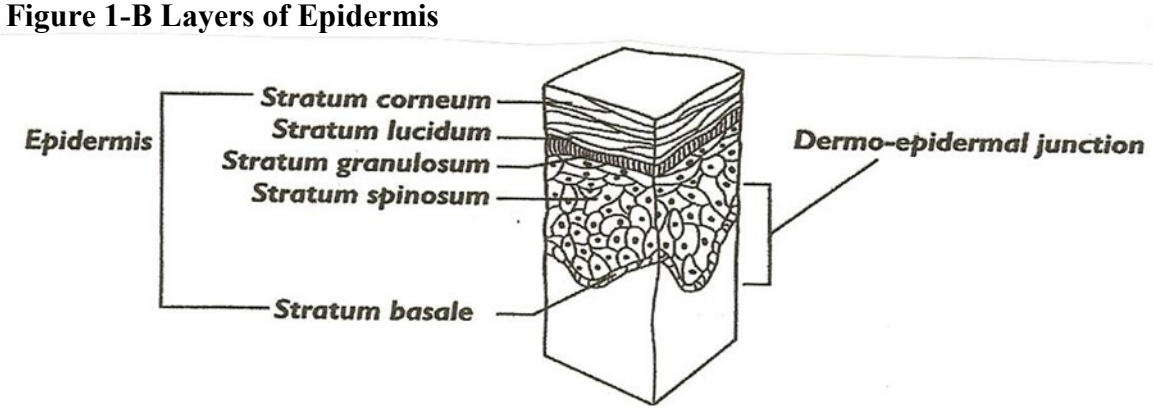


Layers of the Epidermis

The epidermis is divided into five distinct layers. Each layer's name reflects either its structure or its function. They are:

- Stratum corneum (horny layer) is the superficial layer of the dead skin cells
- Stratum lucidum (clear layer) is a single layer of cells that forms a transitional boundary between the stratum corneum and the stratum granulosum
- Stratum granulosum – (granular layer) is one to five cells thick and is characterized by flat cells with active nuclei
- Stratum spinosum – the area in which cells begin to flatten as they migrate toward the skin surface
- Stratum basale or stratum germinatiuum is only one cell thick and is the only layer of the epidermis in which cells undergo mitosis to form new cells

Figure 1-B Layers of Epidermis



Dermis

The dermis is the thick, deeper layer of the skin. It is composed of collagen and elastin fibers and an extracellular matrix, which contributes to the skin's strength and pliability. Collagen fibers give skin its strength and elastin fibers provide elasticity. The dermis also contains:

- Blood vessels and lymphatic vessels, which transport oxygen and nutrients to cells and remove waste products
- Nerve fibers and hair follicles, which contribute to skin sensation, temperature regulation, excretion and absorption through the skin
- Fibroblast cells, which are important in the production of collagen and elastin

The dermis consists of two layers of connective tissue they are:

- Papillary dermis – the outermost layer; which is composed of collagen and reticular fibers that are important in healing wounds. Capillaries in the papillary dermis carry the nourishment needed for metabolic activity.
- Reticular dermis – the outermost layer, which is formed by thick networks of collagen bundles that anchor it to the subcutaneous tissue and underlying supporting structures, such as the fasciae, muscle, and bone.

Glands

There are two types of glands sebaceous glands and sweat glands.

- Sebaceous glands, found primarily in the skin of the scalp, face, upper body, and genital region, are part of the same structure that contains hair follicles. These glands produce sebum, a fatty substance that lubricates and softens the skin.
- Sweat glands are tightly coiled tubular glands; the average person has roughly 2.6 million of them. They are present throughout the body in varying amounts. The palms, and soles have many but the external ear, lip margins, nail beds, and glans penis have none.

The secreting portion of the sweat glands originate in the dermis and the outlet is on the surface of the skin. The sympathetic nervous system regulates the production of sweat, which in turn helps control body temperature.

There are 2 types of sweat glands:

- Eccrine glands – are active at birth and found throughout the body. These glands connect to the skin's surface through pores and produce sweat that lacks proteins and fatty acids. Eccrine glands are smaller than apocrine glands.
- Apocrine glands – begin to function at puberty. These glands open into hair follicles; therefore, most are found in areas where hair typically grows such as the scalp, groin, and axillary region. The sweat produced by apocrine glands contains water, sodium, chloride, proteins, and fatty acids.

Subcutaneous Tissue

The subcutaneous tissue is the tissue that lays beneath the dermis. It is sometimes called the hypodermis. It contains major blood vessels, lymph vessels, and nerves. Subcutaneous tissue has a high proportion of fat cells and contains fewer small blood vessels than the dermis. It varies in thickness depending on body type and location. It insulates the body and absorbs shocks to the skeletal system. It also helps the skin move easily over underlying structures.

Blood Supply

The skin receives its blood supply through vessels that originate in the underlying muscle tissue. Arteries branch into smaller vessels, which then branch into the network of capillaries that permeate the dermis and subcutaneous tissue. The capillaries are the only vessels that have walls thin enough to let solutes pass through; they are typically only a single layer of endothelial cells. The movement of fluids through capillaries is called capillary filtration; this results from blood pushing against the walls of the capillary. The pressure is called hydrostatic pressure- which forces fluids and solutes through the capillary wall. When the hydrostatic pressure inside a capillary is greater than the pressure in the surrounding interstitial space, fluids and solutes inside the capillary are forced out into the interstitial space. When the pressure inside the capillary is less than the pressure outside, fluids and solutes move back into the capillary.

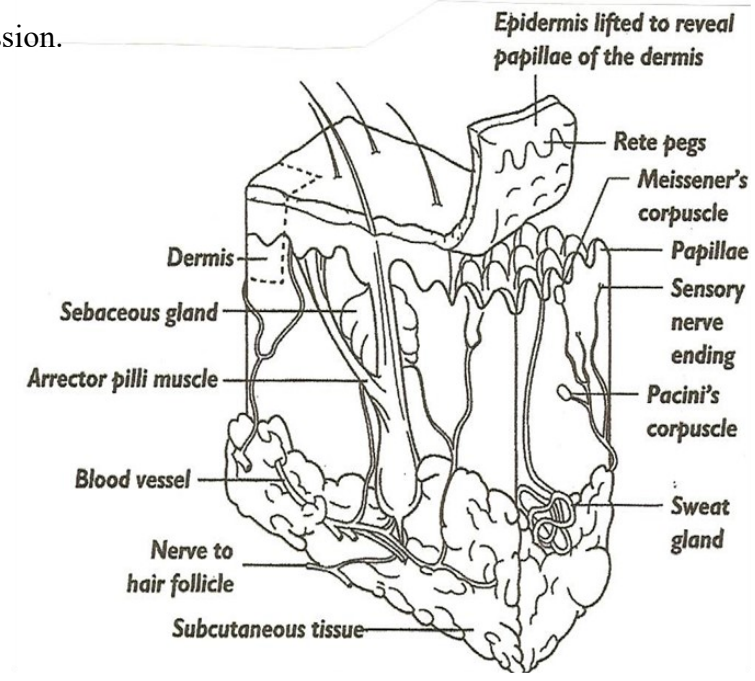
Lymphatic System

The lymphatic system is similar to the capillaries in that they are thin-walled, permeable vessels. However, lymphatics aren't part of the blood circulatory system. They are a separate system that removes proteins, large waste products, and excess fluids from the interstitial spaces in skin and transport them to the venous circulation. The lymphatics merge into two main trunks, the thoracic duct and the right lymphatic duct. These empty into the junction of the subclavian and internal jugular veins.

Functions of the Skin

- Protection – acts as a physical barrier to microorganisms and foreign matter, protecting the body against infection. Protects from mechanical injury.
- Sensory perception – sensory nerves in the skin allow us to have a sense of touch and pressure.
- Thermoregulation – Allows for control of body temperature, involves the concerted effort of nerves, blood vessels and eccrine glands in the dermis.
- Excretion – The skin is an excretory organ; it plays an important part in thermoregulation, electrolyte balance and hydration. A normal adult loses 500 ml of water per day by excretion through the sweat glands.
- Metabolism – The skin helps to maintain the mineralization of bones and teeth. A photochemical reaction in the skin produces vitamin D, which is crucial in the metabolism of calcium and phosphate. Vitamin D is synthesized by the skin.
- Absorption – The skin can absorb some substances through the skin into the bloodstream, the nicotine patch is an example of a product activated by the skin absorption
- Social communication – Skin has a big influence on a person's self esteem. The skin also has an impact on how a person communicates through facial expression.

Figure 1-C Rete Ridges



Aging and Skin Function

A natural part of aging is the ability of the skin to function as efficiently as it once did. As the skin ages, the epidermal rete ridges (pegs) and the dermal papillae begin to flatten. Think of two egg crate mattress stacked with the bumps facing inward. This is what the rete ridges look like and as these flatten, the skin decreases in tensile strength. This leads to the older person being at a greater risk for injuries such as skin tears, pressure ulcers and tumors. Some of the changes that take place are pigmentation, thickness, moisture, turgor and texture.

Some of the changes that increase the risk for wounds as a person ages include:

- A 50% reduction in the cell turnover rate in the stratum corneum (outermost layer) and a 20% reduction in dermal thickness
- Generalized reduction in dermal vascularization and an associated drop in blood flow to the skin
- Redistribution of subcutaneous tissue, which contains fewer fat cells in older people, to the stomach and thighs
- Flattening of papillae in the dermoepidermal junction (meeting of the epidermis and dermis), which reduces adhesion between layers (see figure 1-1, Rete pegs)
- A drop in the number of Langerhans' cells (immune macrophages that attack invading germs) present in the skin
- A 50% decline in the number of fibroblasts and mast cells (cells that play a key role in the inflammatory response)
- Marked reduction in the ability to sense pressure, heat and cold, even through the same number of nerve endings in the skin are retained
- A significant decline in the number of sweat glands
- Poorer absorption through the skin
- A reduction in the skin's ability to synthesize vitamin D

How These Changes Affect the Older Person

- Bruise easier and are more prone to edema around wounds due to reduced skin vascularization
- Are more likely to suffer pressure and thermal damage due to the skins diminished sensation
- Have a higher incidence of ischemia (less oxygen reaching cells) in compressed tissue because bony areas have less subcutaneous cushioning and decreased sensation causes an elderly person to be less sensitive to the discomfort of remaining in one position for too long
- Risk hyperthermia and hypothermia because of decreased subcutaneous tissue
- Have fewer sweat glands and therefore, produce less sweat which hinders thermoregulation and increase the risk of hyperthermia
- Have a higher risk of infection because thinner skin is a less effective barrier to germs and allergens and because the skin contains fewer Langerhans' cells to fight infection and fewer mast cells to mediate the inflammatory response
- Are slower to exhibit a sensation response (redness, heat, discomfort) due to the reduction in Langerhans' cells, resulting in overuse of topical medications and more severe allergic reactions
- Risk overdose of transdermal medications when poor adsorption prompts them to reapply the medication too often
- Have a much higher incidence of shear and tear injuries due to compromised skin layer adhesion that prevents them from noticing the discomfort associated with impending skin tears