

# Basic Biology of the Skin

The skin is often underestimated for its importance in health and disease. As a consequence, it's frequently understudied by chiropractic students (and perhaps, under-taught by chiropractic school faculty). It is not our intention to present a comprehensive review of anatomy and physiology of the skin, but rather a review of the basic biology of the skin as a prerequisite to the study of pathophysiology of skin disease and the study of diagnosis and treatment of skin disorders and diseases. The following material is presented in an easy-to-read point format, which, though brief in content, is sufficient to provide a refresher course to mid-level or upper-level chiropractic students and chiropractors.

Please refer to **Figure 3-1**, a cross-sectional drawing of the skin. This represents a typical cross-section of human skin and features most of the major components in such a typical section of skin. Most skin disease can be characterized as either epidermal, or dermal, or epidermal and eroding, or spreading, into the dermal layer. As will be seen in Chapter 4, Pathophysiology of the Skin, an understanding of normal anatomy and physiology is essential to understanding pathophysiology and serves as a basis to de-mystify many skin conditions.

## ■ Embryology of the skin:

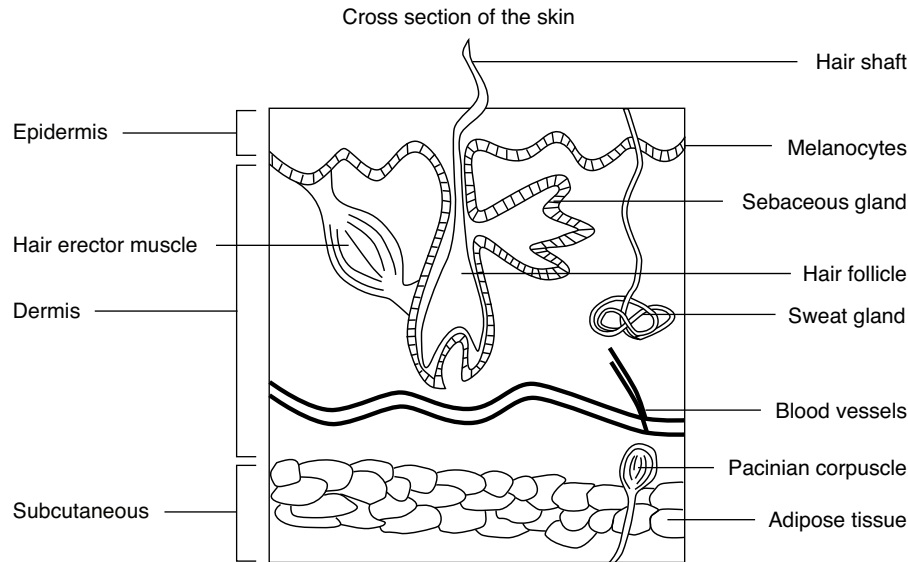
The skin is mainly mesodermal in its embryonic derivation. Specialized skin cells and structures are formed from 3-6 months of gestation.

## Types of skin:

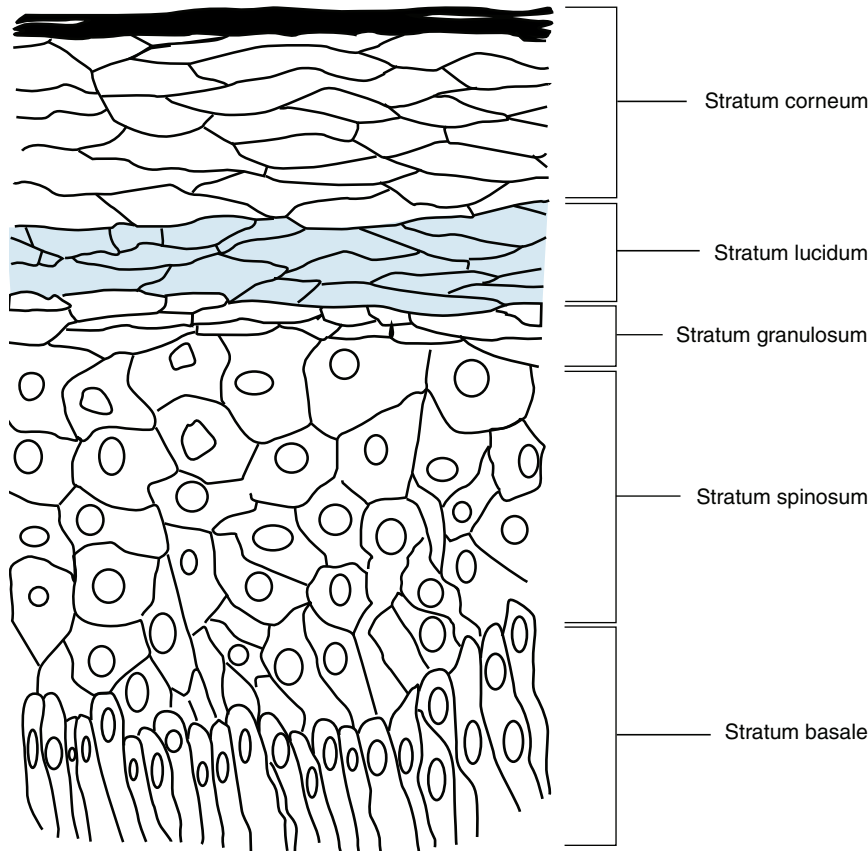
- Non-hairy (glabrous)—a skin type on the palms and soles, it has thicker epidermis and lacks hair follicles.
- Hairy—a type of skin having hair follicles and sebaceous glands.

## Layers of the skin:

1. Epidermis—the outer most layer of the skin that is divided into the following five layers from top to bottom. These layers can be microscopically identified:
  - Stratum corneum—also known as the horny cell layer, consisting mainly of keratinocytes (flat squamous cells) containing a protein known as keratin. The thick layer prevents water loss and prevents the entry of bacteria. The thickness can vary regionally. For example, the stratum corneum of the hands and feet are thick as they are more prone to injury. This layer is continuously shed but is replaced by new cells from the stratum basale (basal cell layer). The stratum corneum constitutes about 15 to 20 layers.
  - Stratum lucidum—this layer is present in the thick skin of palms and soles and consists of a transparent layer of dead cells. It functions as a barrier and also has water proof properties.
  - Stratum granulosum—also known as the granular layer, consisting mainly of stratified squamous cells arranged in 1 to 3 rows containing lamellar granules and tonofibrils. It is important to note that besides the palms and soles, skin lacks a well defined stratum lucidum and stratum granulosum.
  - Stratum spinosum—also known as the spinous layer consisting mainly of a cuboidal cell arranged in multiple layers and synthesizes keratins that function to support structures. The cells are adherent by specialized cells known as desmosomes.
  - Stratum basale or Stratum germinativum—also known as the basal cell layer, is the deepest layer of the epidermis. The layer consists of tall columnar cells that are



**Figure 3-1** Cross-section drawing of the skin showing the epidermis, dermis and subcutaneous layers.



**Figure 3-2** Division of the epidermal layers of the skin.

constantly undergoing cell division and help form new keratinocytes (keratinization) that will replace the lost ones from stratum corneum. This process takes about 27 days. Further down the stratum basale,

the cell layer is attached to a basement membrane which serves as a demarcation or a boundary between the epidermis and dermis. The layer also contains melanocytes containing melanin, Langerhans cells

which recognize antigens and present them to the immune system and Merkel discs which detect pressure on skin.

2. Dermo-epidermal junction—a well demarcated junction that lies between the epidermis and dermis.
3. Dermis—lies between the epidermis and subcutaneous layer. This middle layer of skin contains connective tissue in the form of collagen in bulk and elastin in minimal quantities, with a rich intertwining blood supply. The types of cells located in the dermis are fibroblasts, mast cells and histocytes. Hair follicles, nerves, lymphatic vessels and sweat glands also reside in the dermal layer of the skin.
4. Subcutaneous tissue—also known as the subcutis or hypodermis is the lower most layer comprising mainly of fat (adipose) which provides protection from injury, produces heat and serves as a cushion for the body.

### Innervation of the skin:

- Parasympathetic nerves—consisting of cholinergic neurons that release acetylcholine to the sweat glands.
- Sympathetic—consisting of adrenergic neurons that release norepinephrine to the sweat glands, arteriolar smooth muscle and erector pili muscle.

### Functions of the Skin:

- **Protection and repair** which is provided mainly by keratinocytes while UV protection is offered by melanocytes. The subcutaneous layer protects the deeper body organs. Gentle stroking of the skin with a blunt object can result in white line response caused mainly by capillary constriction. A deeper stroke using a tongue blade will lead to the triple cell response, resulting in a red line, flare and wheal. The wheal is caused by the release of histamine that acts as a vasodilator in local response to injury. The eliciting of the red wheal is known as dermographism that is more pronounced in patients who suffer from hives (urticaria).
- **Skin color** is given by melanocytes that contain melanin.
- **Temperature regulation and excretion of waste products**—sweat glands produce

sweat containing urea and water and play a role in temperature regulation. To facilitate heat loss in hot temperatures, the blood vessels in the skin dilate and sweat glands become active. Alternatively, in cold temperatures skin blood vessels constrict to conserve heat and the body burns fat stored in the adipose tissue. The burning of brown fat under sympathetic stimulation is common in infants. In colder temperatures, the sweat glands become inactive and the erector pili muscles become functional to promote trapping of air for insulation of skin. The adrenergic receptors like  $\alpha_1$ , innervating the skin blood vessels are responsible for vasoconstriction under sympathetic stimulation.

- **Lubrication** of the skin is provided by sebaceous glands, which produce an oily substance known as sebum. Occlusion and infection of these glands can lead to conditions such as acne.
- **Immunity**—Langerhans cells in the skin are dendritic cells that take up microbial antigens in the skin to transform into antigen presenting cells and provide immunity by interacting with T cells. The name Langerhans comes from the German physician and anatomist that discovered these cells in the skin when he was a medical student.
- **Storage**—the skin is an organ which stores fats to provide insulation. This is mainly in the subcutaneous layer.
- **Sensation**—sensation occurs through specialized structures known as mechanoreceptors:
  - Pacinian corpuscle—vibration.
  - Meissner's corpuscle—tapping and flicker, point discrimination.
  - Ruffini's corpuscle—joint movements and stretch.
  - Hair follicle receptor—speed and direction of movement.
  - Merkel's discs—vertical dimpling of the non hairy skin.
  - Tactile discs—vertical dimpling of the hairy skin.
  - Nociceptors—detection of pain.
- **Vitamin D synthesis**—skin is a rich source of 7-dehydrocholesterol and under the effect of UV light is converted into Vitamin D (cholecalciferol) that is ingested mainly from diet such as milk and dairy products.

Cholecalciferol is converted into 25-hydroxycholecalciferol (25-OH) in the liver and finally to activated 1, 25 hydroxycholecalciferol (1,25 OH) in the kidneys. The activated 1, 25 hydroxycholecalciferol plays a vital role in calcium absorption from the intestine and kidneys.

- **Aesthetic**—skin can be seen as a mode of communication or attraction.
- **Absorption**—the skin has the ability to absorb oxygen and water. Certain drugs such as topical steroids that are applied topically could be absorbed through skin surface.

Skin Types:

Skin can be classified based on its reaction to ultraviolet radiation:

Type	Definition	Description
I	Always burns but never tans	Pale skin, red hair, freckles
II	Usually burns, sometimes tans	Fair Skin
III	May burn, usually tans	Darker Skin
IV	Rarely burns, always tans	Mediterranean
V	Moderate constitutional pigmentation	Latin American, Middle Eastern
VI	Marked constitutional pigmentation	Black

Essential skin facts:

- Largest organ of the body.
- Accounts for 15% body weight.
- The organ of the body that is most exposed to bacteria, UV light, toxins, dust and other environmental stressors.
- Every 24 hours the surface of skin sheds dead layer of cells, and on average 40 kg of skin is shed during lifetime.
- Dead skin cells can become a component of household dust.

Structure of the Nail:

- Nail bed—the hard surface of the nail that can be visualized.

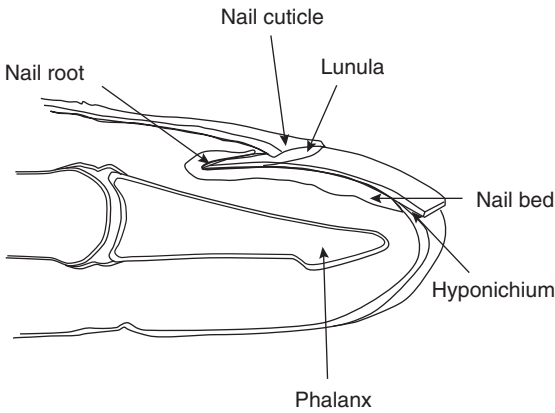


Figure 3-3 Cross section of a typical fingernail.

- Lunula—the half moon shaped structure at the base of the nail.
- Hyponychium—the soft tissue beneath the nail bed.
- Cuticle—the skin that overlaps the nail plate.

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