Chapter 1. An Introduction to Skin

As an esthetician, **skin is your thing**. It is something you need to know inside and out; something you need to understand so well that the knowledge will flow from you like a pure crystal stream. To understand skin well means to be an expert in skin anatomy, skin physiology and skin functions. In this first chapter, you will explore the functions of skin, a topic that is quite controversial even among eminent dermatologists. If you ask the average esthetician about the function of skin, you will get about four or five functions, almost always starting with "the skin is a barrier."

In this textbook, you will venture into many areas of skin science; by looking at skin functions, you are just approaching the great frontier of skin knowledge. The trails blazed by the early investigators of skin through the jungle of ignorance and the deserts of non-science has led to the green pastures of molecular biology and to fields ripe for harvest, albeit only for fertile minds. In this chapter, some new findings in skin science will be explored. In particular, you will look in great detail at the **stratum corneum**. This humble tissue is one of the most complex in the body.

More than a barrier

Skin functions as an **interface between self and non-self** (that is, the outside world). True, it does have some barrier functions, but it is much more than a barrier. Consider that the **skin is an extension of your nervous system**, for it actually arises from the same primitive cells that give rise to the brain, the ectoderm.[1] Skin actually **merges with the environment in a continuous water phase**, while the environment—such as light, heat and food—can become part of you by penetrating into the skin. You also can look at skin as a **thermal regulator**, an **osmotic membrane**, an **immune organ**, an **antimicrobial surface**, a **sensing organ**, a **neuroendocrine organ**, an **intricate system of communication** and an incredible **multipurpose defense system**. Only the skin's barrier function will be covered in this chapter because of the time and energy estheticians spend in understanding and treating skin. The true barrier in the skin is the stratum corneum and its major function is **protection**, or **defense measures**.

Here are a few the protective functions of the stratum corneum and the components of the corneocyte that provides it.

1. Mechanical integrity is derived from the cornified envelope.
2. Antimicrobial defense is provided by the lamellar layers, the extracellular matrix and the toll-like receptors (TLRs).[2]
3. Cytokine production and signaling arises in the cytosol[3] of the corneocyte.
4. Permeability barrier and hydration results from the lamellar bi-layer and the cytosolic matrix.
5. Ultraviolet (UV) protection results from the action of the structural proteins and the trans-urocanic acid.

While all of these functions cannot be fully discussed in this chapter, concentrating on some of them will bring you, the esthetician, important new knowledge and new understanding of the skin.

Stratum corneum—the key

You could almost say with certainty that **to understand the stratum corneum is to understand the skin**. Why would this tiny bit of tissue, only 10–15 microns thick, or about as thick as a skinny sheet of paper, deserve such a dominant place in your thinking about skin? The answer is quite simple: **without the stratum corneum, humans could not survive.** You can live with only part of one kidney, with almost no liver, with no stomach, one lung, a beat up and malfunctioning heart, no legs or arms, no eyes or ears, no spleen and no thyroid gland and so on, but **you cannot live with the loss of even a relatively small amount of stratum corneum.** Widespread loss of epidermis results in the severe complications of dehydration and infection. Mutations in genes that severely compromise epidermal functions have lethal effects, if not at the embryonic stage, then surely for the newborn infant. So critical is the stratum corneum to life that the keratinocyte, the cell that eventually becomes a corneocyte, is endowed with extraordinary powers to survive—**more than any other cell in the body.** How does this flat, very thin, hard cell come into being? Look at FIGURE 1-1 to see the complex nature of the corneocyte of the stratum corneum. This diagram is scaled to 102,000 times the actual size of the stratum corneum, and will be taken apart and explained in this chapter.

The making of a corneocyte

The journey that every keratinocyte must take is a predetermined pathway, programmed not only by the genetic code in your deoxyribonucleic acid (DNA), but also by the needs of the skin. Starting as a soft, mushy round cell capable of endless divisions, the keratinocyte splits to produce a daughter cell, destined to take the voyage to the top. The mother cell, a true stem cell, remains to divide again and again. Follow the daughter cell as she undergoes the changes to become a full warrior corneocyte: while you may have studied this process before, you will be presented with some startling new material this time. See FIGURE 1-2.

The epidermis is a self-renewing tissue. Being proliferate, a small percentage of the keratinocytes must undergo cell division and remain capable of dividing again and again. When a cell divides, the two resulting cells are called the **mother cell** and the **daughter cell**. The mother cell remains capable of dividing again, but the daughter cell will undergo a process called **terminal differentiation**. The process of differentiation is programmed into the cell so that it

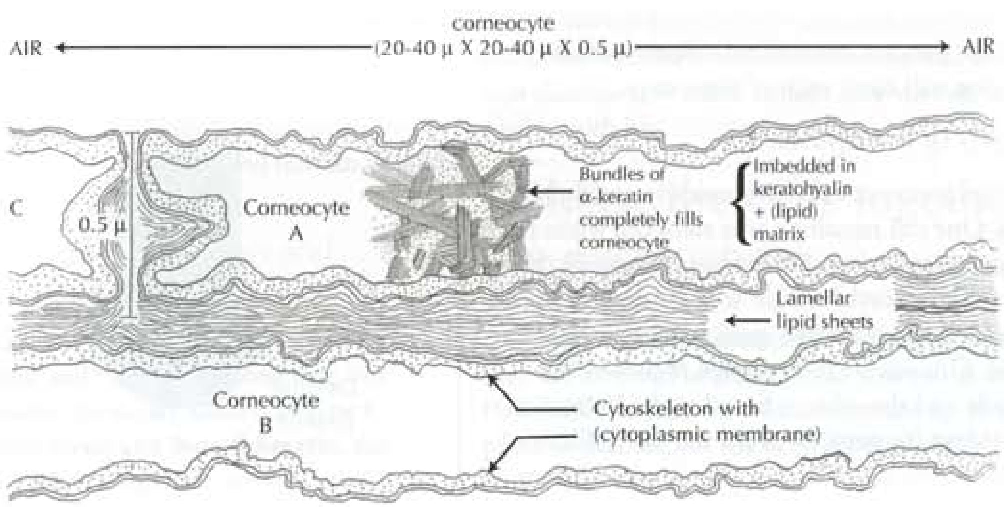

FIGURE 1-1. Drawing of stratum corneum enlarged 102,000 times. Note the fine detail within the corneocytes and in the intercellular spaces. *(Adapted from a Pfizer Inc. illustration by J. E. McKie)*

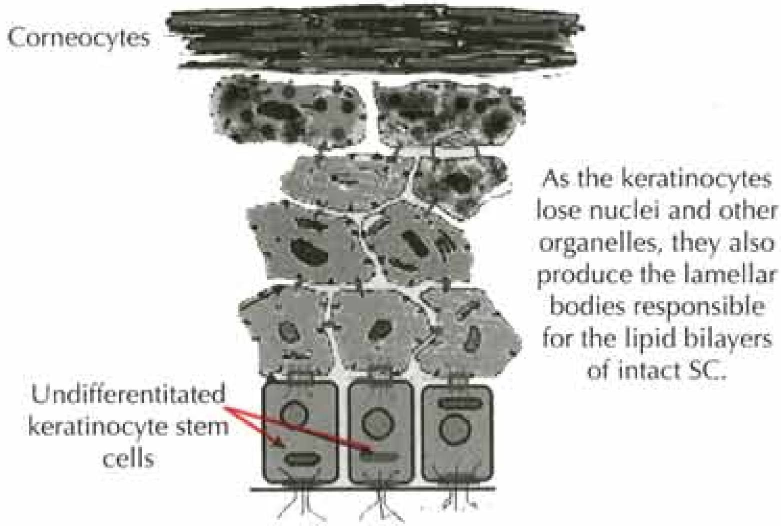

FIGURE 1-2. The process of cornification of keratinocytes. Notice the change in the nucleus of the keratinocyte as it progresses upward in the epidermis.

becomes a corneocyte. However, the type of programmed cell death followed by the keratinocyte is not exactly the same as **apoptosis**,[4] a self-destructive cell death, though both processes share similar mechanisms. There must be a balance between the growth of the new cells and the death of the differentiated cell; otherwise there would be a pathological state of either too many cells or too few cells. The process is controlled by **how many stems cells are formed, the rate of keratinocyte proliferation** and **the process of terminal differentiation.** This chapter will cover each of these steps.

Stem cells of the epidermis

Keratinocyte stem cells divide slowly to produce two cells. One cell remains a true stem cell while the other is programmed to differentiate. The stem cells are sensitive to ultraviolet light so they are protected by being located within two special areas of the epidermis. One occurs in the **bulge region of the hair follicle** and the other is found at the **bottom of the rete ridges** (or **pegs**) between the hair follicles of the epidermis. Actually, there are two types of stem cells. The stems of the bulge region are **multi-potent**, which means they can generate all kinds of epidermal cells, such as hair follicles, sebaceous glands or epidermal keratinocytes. The rete ridge stems cells, on the other hand, can produce only **keratinocytes**.

It is the job of the stem cells to keep the cell population under a genetic watchful eye; when damaged cells or damaged tissue is present, the stem cells will grow faster to repopulate the damaged site. When stem cell replication is uncontrolled, however, the end result may be a cancer such as basal cell carcinoma or squamous cell carcinoma. This frequently occurs when skin has been exposed to ultraviolet light at levels or exposure times capable of producing deoxyribonucleic acid (DNA) damage to the stem cell. Loss of too many stem cells, or stem cell nonproliferation, can produce an aged-looking epidermis.

The proliferate phase

The **transient amplifying (TA) cells** are responsible for most of the epidermal keratinocytes. TA cells are attached to the basement membrane by **integrin proteins** in the epidermis. The first step in the process of keratinocyte differentiation is initiated by the transition of the stem cell to a TA cell. Next, the TA cell travels laterally, moving along the basement membrane while undergoing cellular proliferation. TA cells have limited ability to divide, as they no longer are stem cells. A TA cell can divide only two to three times before losing its ability to divide. This actually is a biological advantage, in that the TA cell is doing most of the cell renewal without risk of permanent genetic damage to the epidermal stem cells. It works like this: in long-lived cells, each DNA replication may produce a mis-transcription; the

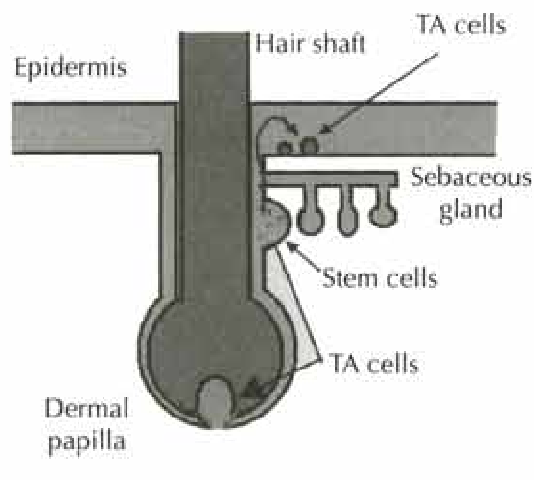

FIGURE 1-3. The concept of the stem cell and the transient amplifying cell (TA cell). Note that the stem cells are below the sebaceous gland outlet and that they send TA cells both to the surface and to the hair bulb.