



The Hair Follicle and Depilatories...

Excerpted from "Advanced Professional Skin Care, Medical Edition"
by Peter T. Pugliese

The Hair Follicle

The hair follicle also is termed the "pilosebaceous apparatus" for it consists of the hair shaft, hair bulb, sebaceous gland and the apocrine gland. You could use either term and be correct, though hair follicle is used at times to refer only to the hair bulb and shaft.

You will find hair follicles all over the body except on the palms and the soles. Hair follicles are present at birth but do not develop into their mature form until puberty. Some parts of the body, such as the breast and the ear canals, have only the apocrine glands without the rest of the apparatus. You must remember that the hair follicle develops from the epidermis at about nine weeks of fetal life, with the sebaceous gland appearing at 13 weeks and the apocrine gland at 17 weeks. The entire apparatus can be found in the axilla, in the pubic area, on the face, and on the chest and back.

The Hair Structure

Each hair begins as a bud, or peg, and grows by the division of cells from the hair bulb located in the dermis. See FIGURE 3-13. Only the lower, growing end is alive; the rest of the hair is a compact mass of keratin. The three parts of the hair when examined in cross section are the cuticle, the cortex and the medulla. Each hair has a nerve plexus and a blood vessel plexus. You must study the hair growth cycle to understand the hair.

The Hair Growth Cycle

Hair grows in three phases. Telogen is the resting stage or club stage. Anagen is the growth stage. Catagen is the regression stage. During telogen, the club hair is high in the follicle and the lower hair bulb is inactive. When anagen starts, there is a great increase in mitotic activity and a downward growth of the hair bulb. The hair shaft grows upward and dislodges the club hair. When this stage is over, the hair bulb ceases mitosis and moves up in the dermis, and the hair shaft becomes a club hair again. See FIGURE 3-14 for this cycle.

Types of Hair

Hair is classified as vellus hair when it is soft and fine, very short and unpigmented. You see vellus hairs on the non-hairy parts of the body as fine "down." These hairs have a short anagen and a long telogen. Terminal hairs are the heavy, coarse, long and pigmented hairs seen in the hairy areas of the body: Scalp, beard, pubic areas, eyebrow and eyelash, and in the axilla. The intermediate hairs fall in between the size and shape of the vellus and terminal hair. They are found frequently on the arms and legs of adults.

Hair follicles also may be classified as non-sexual and sexual depending on how they respond to hormones. Ambosexual hair follicles are found in both sexes and respond to androgens. They are converted from vellus to terminal hairs at puberty and are found in the pubis and in the axilla. Male sexual hair responds only to androgens and is seen in the beard area, the ears, nasal tip, chest and pubic area.

Stem Cells and Hair Growth

For many years, people believed that hair growth originated from stem cells at the base of the hair. Recently, scientists discovered that stem cells in the hair follicle are located around where the erector pili muscle is inserted. This and subsequent work have changed the thinking not only about hair growth, but also about how skin heals. Stem cells will be discussed in more detail when cells are described. For now, you need only remember that stem cells are primitive cells that are capable of differentiating into more than one type of end cell. An end cell is a cell that cannot differentiate further and essentially is either a permanent cell such as nerve cell, or a cell that will have a limited life span, such as a skin keratinocyte (about 40–50 days) or red blood cell (about 120 days).

The hair follicle is not just a hair factory. Researchers now have discovered that the hair follicle is the source of new cells for the skin's outermost layer, the epidermis, which is replenished throughout life. These cells, according to a study by researchers

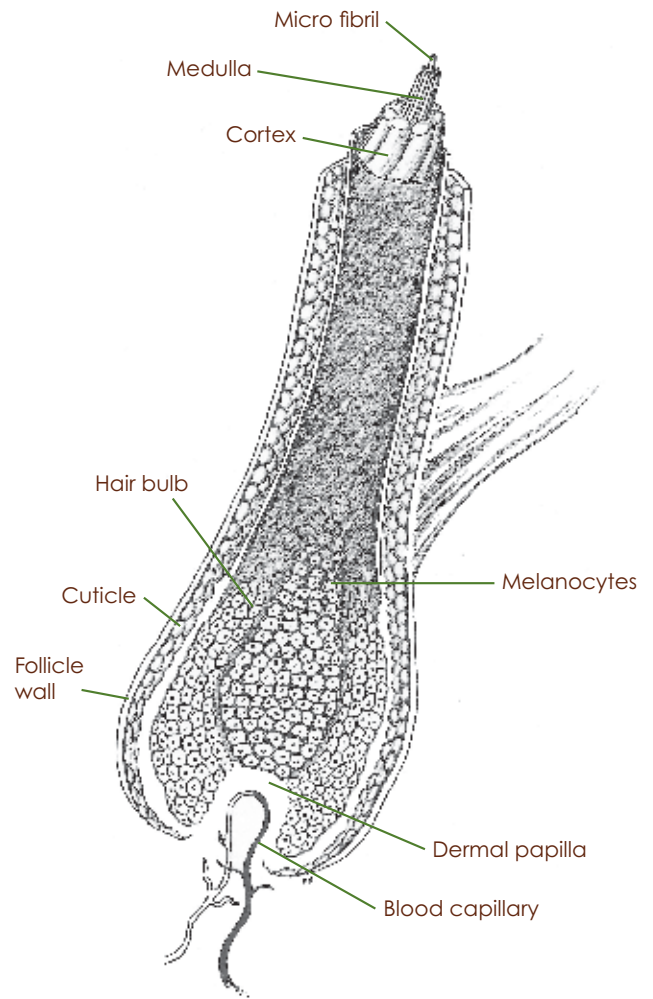


FIGURE 3-13

at New York University School of Medicine and the University of Pennsylvania School of Medicine, reside in a well-protected area of the follicle, called the "bulge," that lies just underneath the skin. Epithelial stem cells are primitive progenitor cells that supply the cells needed for replenishing the skin, one of the body's self-renewing tissues. These cells are not related to the stem cells found in the bone marrow.

All these findings suggest that certain types of skin cancer probably arise from epidermal stem cells found in the bulge, because these cells and their progeny are located near the skin's surface within easy reach of chemical carcinogens. This new concept also may provide new therapeutic approaches to a variety of epidermal skin diseases such as psoriasis, which may involve epithelial stem cells.

The Sebaceous Glands

Sebaceous glands are widely distributed over the body. They are on the face, scalp, back and chest in profusion. They are absent on the soles, palms and lower lip. Every hair is associated with a sebaceous gland but not all sebaceous glands are associated with hair follicles. When hair is present, they are called sebaceous follicles; these can be found on the face, back, chest, buccal mucosa, nipples, upper lip, prepuce and the glans penis.



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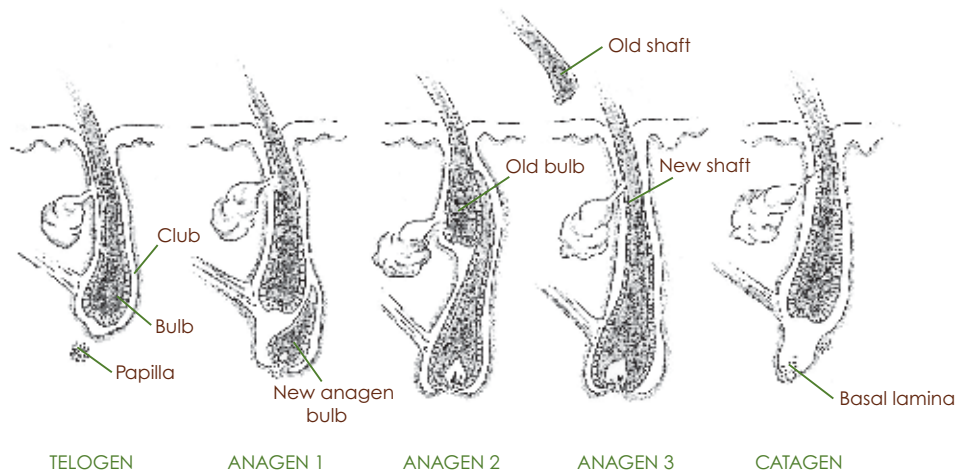


FIGURE 3-14

area, the anal area, the mammary areolae, and the face and scalp; they develop at puberty.

In the ear, apocrine glands produce ear wax, or cerumen. In the eyelids they are called the glands of Moll. They are about as numerous as the sweat glands in the axilla. Otherwise, they are believed to occur at about one apocrine gland to every 10 sweat glands.

Apocrine glands are located in the lower dermis, and are complex tubular structures with compound secretory coils. Their ducts run parallel to the hair follicle and empty above the sebaceous gland. Their

secretion is thicker and more complex than that of true sweat glands, which will be considered later.

The Sweat Glands

Two entire industries have arisen around this gland – the antiperspirant industry and the air conditioning industry. The sweat gland, or sudoriferous gland (sudor meaning “sweat”), is employed to regulate body heat. The underlying principle of this system is evaporation of water. The heat required to change water from a liquid to a gas or vapor is taken from the body and used up in this conversion. As a result, the body cools down as the sweat evaporates; for this article, however, you need to know only the basic principle of heat control.

There are two to three million sweat glands in the human body with varying distribution in different regions of the body. The soles of the feet have the most, 600 per square centimeter; and the legs have the least, 150 per square centimeter. These glands are distributed widely in humans, but very limited in other animals. Monkeys and apes have the same sweat glands as humans but at a much lower density – fewer glands per square centimeter.

The Apocrine Gland

Apocrine glands are the real mystery glands of the skin and much has been written about their purpose. It is believed that they are vestigial glands in humans, without any true function at this stage of evolution. They are found in the axilla, the pubic

The Eccrine Gland

Sweat is composed mainly of water (99%), with minute quantities of dissolved substances that include sodium chloride, urea, sulfates and phosphates. Sweat is odorless until bacteria act upon it, producing body odor. The sweat gland consists of two components, a secretory coil and a duct. There are three cell types in the secretory part of the gland – secretory, or clear; mucoid, or dark; and myo-epithelial.

The secretory coil rests directly in the basement membrane and is an irregularly coiled tube. The tube is lined with a single layer of epithelial cells that surround an open space, called the lumen. Within the duct are the clear and the dark cells. The function of the dark cells remains unknown. Their composition is not fully known, but they contain a granular substance that is a mucoprotein. The clear cells are believed to be the true secretory cells of the sweat gland, in that the secretions of the gland on the skin come from these cells. They contain many mitochondria.

A note on depilatories for black skin: Black males have a problem with regrowth of hair into the skin after shaving. This condition arises out of the curved nature of black facial hair. As the sharp, shaved hair enters the skin, it sets off an irritation reaction called pseudofolliculitis barbae. A powder preparation that uses barium sulfide and calcium thioglycolate can be used for this condition; it will remove facial hair in three to seven minutes. This area needs more research and product development.

An intricate infolding of the cell membrane forms the basal labyrinth. Where two or more clear cells join, there are structures called intercellular canniculi that connect the cells with delicate passageways that drain eventually into the lumen of the tube.

The sweat duct starts abruptly after the secretory portion. It is characterized by having two to three layers of cells rather than a single layer, but it is narrower than the secretory duct. As the duct rises, it becomes wider; it starts to form a spiral in the epidermis. At the surface it is quite wide when compared to the lower part.

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Just before the tube opens onto the surface, the body absorbs key salts in order to maintain a healthy balance.

Nerves and blood are plentiful in sweat glands. An unmyelinated nerve from the sympathetic system supplies the gland. However these nerves function as if they were a part of the parasympathetic system.

The myo-epithelium are cells that are located in the basal lamina of the gland,

between the lamina and the clear cells. These cells act like smooth muscle cells and contract in response to stimuli, but they appear to be independent of some secretory functions.

The basal lamina surrounds the secretory portion of the gland. It is contiguous with the basement membrane of the epidermis but it is immunologically distinct.

Depilatories

Depilatories have been used since ancient times. This is one of the oldest types of cosmetic preparation, after eye makeup and primitive foundations (mud). The original depilatory formula was called rhusma and was made up of quicklime and arsenical powders on a ration of 1:2. The powder was mixed with wood ash as a source of alkali. This was obviously quite toxic, though very effective.

Three types of hair removal are used today besides shaving. Epilating refers to pulling the hair out either with tweezers or waxing. Electrolysis uses electricity to destroy the hair at the base of the shaft. The use of chemicals to destroy or weaken the hair is called chemical depilation. This section discusses only waxing and chemical depilation.

Epilating By Waxing

This is probably the most common method used by the skin care specialist to remove hair. Most doctors are not enthused about this method because of the incidence of infection associated with its use. In the hands of a skilled operator, though, this is a safe and effective method. The formulas for most waxes are based on combinations of beeswax and rosin, with the major component being rosin. Rosin hardens and holds the hair. Some preparations use paraffin and petrolatum as well. The use of camphor in preparation will reduce discomfort. Adding an antimicrobial agent will reduce the chance of infection.

This significant caution regarding using wax treatment is to avoid any area that has any redness or sign of infection. Also, be wary of individuals with psoriasis or chronic eczema. People who bruise easily or blister easily are also not good candidates for this type of treatment.

Chemical Depilation

Chemical depilatories should be non-toxic and nonirritating to the skin as well as being effective in three to six minutes. Most depilatories contain an alkaline reducing agent that weakens hair shafts by breaking the disulfide bridges (the cystine group) between the polypeptide chains in the keratin molecules of hair fibrils. Here are some basic types of preparations, with brief explanations of how they work.

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Sulfides such as strontium sulfide are effective with three to five minutes after application. Unfortunately, they also generate hydrogen sulfide, which has the unpleasant odor associated with rotten eggs. You can cut down on the odor by scraping off most of the product with a wooden spatula before washing off the residue. The addition of water releases the smelly hydrogen sulfate. However, the product must be washed off as prolonged exposure will damage the skin. Sulfides are toxic to deeper tissues and should never be used on broken skin. A typical preparation may contain the following ingredients: Strontium sulfide, talc, methyl cellulose, glycerol, fragrance and water. Stable sulfide formulations are not easy to put together and require great attention to detail.

Stannites are tin-derived products that are relatively odor-free. They have not been very popular, however, because they are not stable. Attempts at using various stabilizers have not been very successful.

Thioglycolates are the current choice for depilatories. Used in concentrations of 2.5 to 5 percent, thioglycolate products are nontoxic and stable. They work in five to 15 minutes depending on concentration and formula. For rapid action, the product pH should be around 9.5 to 12.5, though more advanced research suggests that you can have slightly lower pH and still have an effective product. They may include glycerol to form thiglycerol. There are many thioglycolate formulas on the market and more will continue to appear because they are safe, stable and effective.

Enzymes that attack keratin are the newest form of depilation. There is a keratinase available, produced by the microbe *Streptomyces fradiae* that will dissolve keratin. An old patent on this type of product (US Patent 2 988 485, 1961) was issued 30 years ago. New enzyme technology promises to improve this method; unfortunately, much of the newer technology still is proprietary. At present, enzyme depilation systems are slow and costly.



*Peter T. Pugliese, M.D. has been the undisputed pioneer of cosmetic research, formulation, and education in the field of skin health. He has spent more than 50 years dedicating his life to research and science. His research in the field of anti-aging and skin physiology has given him numerous awards, patents, and discoveries which have influenced the course of professional skin care around the globe. Pugliese has contributed chapters to over a dozen books and published over 60 scientific papers. He has authored four books, including, in 1990, the first textbook written for aestheticians by a physician, *Advanced Professional Skin Care*, to bridge aesthetics and medicine with a common language. His newest publication is *Advanced Professional Skin Care – Medical Edition*; 800-630-4710, 610-780-9808, www.circadia.com, or www.pattipugliese.com.*

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