

PART I: CUTANEOUS FORMULATION ISSUES

2

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An important consideration in formulation technology is the target site for product application. Should a skin care product be formulated for the entire body or are there unique needs for specific body sites? As a dermatologist, I am keenly aware of the need to look at each anatomic area individually to achieve optimal product functioning. Failure to do so leads to development of a product that works everywhere and nowhere. The goal of this section of the text is to explore the uniqueness of the skin in various body locations to provide a foundation for anatomic formulation considerations.

To understand formulation needs of each body area, several basic concepts must be elucidated. First, the anatomy and physiology of the body site must be identified. For example, is the skin in the area bearing hair, sebaceous gland rich, transitional between dry and moist, marked by the presence of sweat glands, hormonally mediated, acne prone, age related, etc. The second basic consideration is a discussion of the dermatologic diseases that may afflict the given skin area. Good skin care products should supplement prescription medications when disease is present, but also maintain the health of the skin and prevent disease recurrence once resolution of the dermatologic problem has occurred. Third, the hygiene needs of the skin should be considered. Is there natural bacterial colonization of the site? Is the site a mucous membrane with little resistance to viral particle penetration? Lastly, thought should be given what constitutes skin health in the area and what skin care needs should be met to allow maintenance of this health.

Only after all of these particular formulation issues have been considered can a truly quality product begin the development process. Failure to give the necessary forethought will result in a product that is met with initial enthusiasm, due to well-constructed marketing claims, but poor long-term product performance, due to lack of efficacy. This formulation textbook begins with this chapter, since these ideas form the next logical step in product development following product conception.

SITE-SPECIFIC CUTANEOUS NEEDS

Many unique body areas require consideration. The face can be considered as a whole; however, the eyelids and the lips represent unique facial areas that demand separate

evaluation. The thicker skin of the hands and feet is different from anywhere on the body with a transitional area occurring between the rigid nails and the surrounding cuticle and soft tissue. The abundant sebaceous glands and terminal hair follicles on the scalp make this a separate skin environment, along with skin that expands and contracts with movement in intertrigenous areas such as the neck and the underarms. The female and male genitalia are also unique with numerous glandular and follicular structures that present a hygiene challenge. Everything else that is covered by skin can be simply labeled as the body. Let us begin by examining each of these skin environment areas separately.

Face

The face begins at the anterior hairline, stops at the ears, and is bounded by the lateral jawline and chin. It is the most complex and challenging area of the body for the formulator, yet more products are designed for facial use than any other. Why? Because the face is the purveyor of our image, our personality, our health, and our age. It identifies who we are, how we are, where we are, and sometimes what we hope to be. From a dermatologic standpoint, the face possesses unique medical attributes. It contains all of the glandular structures of the body, including hair, and is characterized by dry skin and transitional skin. The transitional skin is found around the eyes, nose, and mouth. It is also frequently afflicted by a variety of skin diseases that complicate product development.

Anatomy and Physiology

Let us begin by considering the anatomy and physiology of the face. The facial skin is the thinnest on the body, except for that around the eyelids. This means that the skin is easy to injure, but also readily healed. It is for this reason that skin surgeons prefer to operate on facial skin. Incisions heal imperceptibly due to the minimal movement of skin on the face and the fact that the face is not weight bearing. Compare the facial skin to that of the upper chest, which heals extremely poorly. The chest skin is constantly subject to pulling and pushing as the arms move, which predisposes any chest incision to healing with a thickened hypertrophic scar. Compare the facial skin to that of the lower ankles, which is some of the slowest healing skin on the body, because it must bear a load with walking accompanied by constant movement. Indeed, the facial skin is some of the most forgiving on the body when it comes to surgical manipulation.

On the other hand, the facial skin is some of the least forgiving when it comes to irritation and allergy. The thinness of the facial skin that is so desirable for healing purposes allows the ready penetration of irritants and allergens, making product formulation more challenging. The face is also characterized by numerous follicular structures in the form of pigmented terminal or full thickness hairs in the eyebrows, eyelashes, and male beard combined with white fine downy vellus hairs over the rest of the face. These follicular structures are the transition between the skin on the surface of the face and the ostia, or openings, that lead down into the follicle itself and the associated sebaceous or oil glands. The follicular ostia forms the structure that is commonly referred to as a pore. The follicle creates the interesting topography of the facial skin with mountains occurring around each follicular structure and intervening valleys in between. This unique topography is known as dermatoglyphics, which forms the pattern and texture of the skin. Prominent dermatoglyphics lead to what is termed coarse skin while a more even skin surface with smaller pores leads to fine skin and better texture.

At the base of the pore lies the hair follicle just below the oily sebaceous gland. The skin lining of the pore connecting the surface to the depth of the follicle is an important

transitional area. This is the skin that sloughs improperly creating the environment appropriate for acne. It is also the skin that is easily irritated resulting in the “breakouts” experienced following the use of products that cause the formation of red bumps, known as papules, and pus bumps, known as pustules. This skin cannot be reached by traditional cosmetics and skin care products, but irritant or allergic reactions that occur at the skin surface can impact this follicular lining.

The pore is not only connected to the hair, but also to the sebaceous gland. The sebaceous gland is the structure that produces sebum. Sebum is the oil of the body that lubricates the skin surface, but also provides a food supply for bacteria, such as *Propionibacterium acnes*, and fungal elements, such as pityrosporum species. The bacteria *propionibacterium acnes* digests the sebum releasing free fatty acids that initiate inflammation characterized by the influx of white blood cells. These white blood cells form the pus that is seen with acne. Pityrosporum species are responsible for the initiation of the inflammation, also due to the release of free fatty acids, which is associated with the onset of dandruff of the scalp and face. Dandruff of the face is medically termed seborrheic dermatitis.

The facial skin also contains two types of sweat glands, known as eccrine and apocrine glands. Eccrine glands are the sweat glands that produce a sterile watery liquid associated with the maintenance of body temperature. It is the evaporation of the sweat from the skin surface that allows excess heat to be rapidly removed from the body. However, on the face sweating can occur in response to emotion and the ingestion of spicy food. This type of sweating is under a different neural control than that associated with thermoregulation. The other type of sweat gland, known as an apocrine gland, produces a scented sweat that is unique to each individual. This apocrine sweat contributes to body odor and allows certain perfumes to smell differently on each individual. The apocrine sweat glands are uniquely located around the eyes.

Our discussion to this point has focused on the anatomic structures present on the facial skin to include pores (follicular ostia), terminal hairs, vellus hairs, sebaceous glands, eccrine glands, and apocrine glands. The face possesses a larger variety of these structures than any other skin on the body, which makes it unique. But, the skin on the face is structurally identical to any other skin on the body in that it is composed of two layers, to include the epidermis and the dermis. The epidermis is the outer layer of skin, which is covered by a thin layer of nonliving skin cells, known as the stratum corneum. The stratum corneum is the layer of skin with which all skin care products interact. It is this structure that is impacted by the majority of formulations concocted by the cosmetic chemist. Beneath the epidermis lies the dermis. The dermis is the collagen-rich, structurally strong layer of skin. It is the dermis of cow hides that is turned into leather. The dermis actively participates in the immunologic surveillance of the body and produces a scar if injured. For all practical purposes, the cosmetic chemist is not concerned with the dermis as this is the realm of prescription drugs.

The stratum corneum represents the skin barrier and is integral in differentiating those substances that must remain outside the body from those that are allowed to enter through the skin. It accomplishes this end by a unique arrangement of dehydrated skin cells, known as corneocytes, interspersed between a combination of oily substances, known as intercellular lipids. The intercellular lipids implicated in epidermal barrier function include sphingolipids, free sterols, and free fatty acids^a. This organization has been likened to a brick wall where the bricks are represented by the nonliving corneocytes

^a Elias PM: Lipids and the epidermal permeability barrier. Arch Dermatol Res 270:95–117, 1981.

and the mortar is represented by the intercellular lipids. Any disruption in this organization, either through removal of the corneocytes or intercellular lipids, results in a barrier defect that can ultimately result in skin disease, our next topic of discussion.

Common Dermatologic Disease Considerations

The causes of most facial skin diseases that can be impacted by skin care products are due to barrier defects. The barrier defects are mostly due to removal of the intercellular lipids resulting in excessive water loss from the skin surface, a phenomenon known as transepidermal water loss. This loss of water from the skin produces dryness, known as xerosis, with the onset of flaking of the facial skin later accompanied by redness and swelling. These physical findings are associated with the subjective findings of tightness, itching, stinging, burning, and pain, in order of increasing skin disease severity. It is the onset of this transepidermal water loss that is necessary to initiate synthesis of intercellular lipids to allow barrier repair^{b,c}.

The skin disease that results from dryness is known as eczema. Eczema is treated by creating an environment suitable for barrier repair to occur. Most dermatologists recommend decreased bathing and use of a mild detergent to prevent further undesirable removal of the intercellular lipids. They also recommend the use of oily moisturizers to create an artificial barrier soothing irritated nerve endings, thus preventing itching and pain, and to decrease transepidermal water loss. Moisturizers are used not to hydrate the skin, but rather to minimize further damage while the skin is healing the barrier endogenously.

It is worth mentioning that some individuals are more susceptible to barrier damage than others. For unknown reasons, some persons may have defective intercellular lipids, insufficient secretion of intercellular lipids, or corneocytes that are less resistant to structural damage. These persons will demonstrate barrier defects more readily than others and will have eczema that is harder to control and sometimes impossible to cure. These individuals are classified as possessing sensitive skin and are used in cosmetic testing panels for this reason.

The other common facial skin conditions of acne, acne rosacea, and seborrheic dermatitis are due to a completely different mechanism of action. They may ultimately result in a facial skin barrier defect, but can be considered diseases of the facial skin biofilm. The biofilm is that thin layer of sebum, eccrine sweat, apocrine sweat, skin care products, cosmetics, medications, environmental dirt, bacteria, and fungus that is present on the skin surface. A healthy biofilm will lead to skin health while biofilm abnormalities will ultimately lead to disease. For example, as has been mentioned previously, an overgrowth in the facial flora of *propionibacterium acnes* will lead to acne. Without *propionibacterium acnes* there can be no acne. Thus, skin care products can impact facial acne by minimizing the growth of this organism on the face. *Propionibacterium acnes* is also felt to be operative in an adult acne condition associated with facial redness and papules and pustules known as acne rosacea.

Seborrheic dermatitis is different from acne in that it is caused by a fungus, known as *pityrosporum*. This fungus is normally found on the facial skin in small numbers with its growth kept in check by the immune system. Seborrheic dermatitis, characterized as dandruff of the face, is more common in the elderly, persons with AIDS, after severe

^b Jass HE, Elias PM: The living stratum corneum: implications for cosmetic formulation. *Cosmet Toilet* 106 October 1991:47–53.

^c Holleran W, Feingold K, Man MQ, Gao W, Lee J, Elias PM: Regulation of epidermal sphingolipid synthesis by permeability barrier function. *J Lipid Res* 32:1151–1158, 1991.

medical illnesses, and following chemotherapy. Sometimes severe untreatable seborrheic dermatitis is the first indication that an immune problem may be present. Skin care products can dramatically affect the presence of fungal elements on the facial skin, thus minimizing or maximizing the chances of developing seborrheic dermatitis through proper hygiene, discussed next.

Hygiene Needs

The hygiene needs of the face are more complex than any body area, except for perhaps the genitalia. This is due to the interplay between the skin, the hair, the sebaceous glands, the eccrine glands, and the transitional skin around the eyes, nose, and mouth. The moist skin of the nasal mucosa and the oral mucosa is an environment perfect for bacterial colonization and growth. Bacteria from these sites can easily move onto the facial skin covered with a mixture of sebum and sweat perfect for encouraging bacterial growth and spreading infection. The presence of hair also provides added surface area for bacterial growth to occur, thus the facial skin is a common site of infection.

Good facial hygiene is a careful balance between maintaining a healthy biofilm while preserving the integrity of the barrier by leaving the intercellular lipids intact. This can be challenging in light of the fact that cleansers cannot accurately differentiate between sebum and intercellular lipids. It is further challenged by the ever changing sebum production of the facial glands, which varies by both age and climate, and the different bacteria with which the body comes in contact. Many dry complected individuals fail to clean the face due to the fear that dryness will result. Ultimately, disease results. Thus, facial skin must be kept clean, but not too clean.

Skin Care Needs

In many cases, barrier damage from meeting the hygiene needs of the skin must be balanced by the use of additional skin care products. Thus, the skin care needs of the face are influenced not only by the unique attributes of the facial skin, but also by the needs created through the use of other skin care products. What are the skin care needs of the face? They are the maintenance of skin health and the enhancement of skin beauty. These are two very different goals. The maintenance of skin health has already been discussed as optimization of the biofilm, which is a careful balance between cleansing (Chapter 4) and moisturizing (Chapters 6, 7). Yet, there are other skin needs. These include the creation of an even skin surface and the prevention and reversal of skin damage.

The image of healthy facial skin is shiny skin due to abundant light reflection. This light reflection is due to an even surface. Causes of uneven facial skin include scars, facial growths such as moles, skin disease such as acne, and retained dead skin cells from the stratum corneum, known as corneocytes. Little can be done cosmetically to affect facial scars and moles, while acne issues have already been discussed. One area that deserves further mention is the issue of retained corneocytes. During youth the corneocytes slough easily as the cellular message for cell disadhesion is well transmitted. With advancing age, the cells do not disadhere or desquamate as readily leading to retained dead skin scale. This skin scale, or dander, creates an uneven skin surface. This has led to the concept of exfoliation, which uses chemical or mechanical means to encourage the removal of the dead skin scale. Exfoliants (Chapter 15) are the product category addressing this need. Exfoliation through the use of mild acids in astringent formulations (Chapter 5), such as glycolic or lactic acid, or the use of abrasive scrubs or textured cleansing cloths removes the skin scale improving skin texture and skin shine.

The other major skin need is the prevention and reversal of skin damage from sun exposure. Sun contains UVB and UVA radiation, both of which damage the skin. This damage can be seen in the form of collagen loss resulting in premature skin wrinkling or abnormal pigmentation resulting in uneven skin color. Facial skin care products have been developed to meet these needs. Sunscreens (Chapter 9) are the most important anti-aging facial skin care products currently available for their ability to absorb, scatter, or reflect UVB and/or UVA radiation. After cleansing for good facial skin hygiene, sunscreen is the most important facial skin care product to maintain skin health. Unfortunately, sunscreen is not completely effective in preventing UV damage and compliance, especially during youth, is not 100%. Thus, skin lightening preparations (Chapters 13, 14) are available to even irregular pigmentation and antiaging products (Chapters 9, 10, 11, 12) attempt to reverse facial skin damage once it has occurred.

Eyelids

From the face, we will now move to a discussion of the eyelids. The eyelid skin is some of the most interesting on the body. It moves constantly as the eyes open and close; thus, it must possess unique mechanical properties. It must be thin enough for rapid movement, yet strong enough to protect the tender eye tissues. Eyelid tissue shows the state of health and age of an individual more rapidly than any other skin of the body. When others comment on a tired appearance, they are usually assessing the appearance of the eyes and the eyelid tissue. When others comment on a sickly appearance, they are also assessing the appearance of the eyes and the eyelid tissue. The eyelid skin appears to age quickly resulting in the presence of redundant upper eyelid tissue and lower eyelid bags. The redundant upper eyelid tissue is due to loss of facial fat, cumulative collagen loss in the eyelid skin from UV exposure, and the effect of gravity pulling down the upper eyelid skin. Lower eyelid bags are also due to the effect UV damage and gravity, but edema or swelling may also contribute. This edema may be due to retained body fluids or the release of histamine from inhaled allergens. All of these factors contribute to the complexity of the eyelid skin.

Anatomy and Physiology

The eyelids are indeed composed of unique skin. It is the thinnest skin on the body, accounting for the eyelids as the most common site of irritant contact dermatitis and allergic contact dermatitis, either from products that are directly applied to the eyelids or from products transferred to the eyelids by the hands. The eyelid skin also has a paucity of sebaceous glands, making it a common area of skin dryness. While there are no hairs on the eyelids themselves, the eyelashes form an interesting transition between the keratinized eyelid skin and the cartilage of the tarsal plate giving structure to the edge of the eyelid. Tearing from the eye impacts the skin of the eyelid, since wetting and drying of the eyelid tissues can predispose to dermatitis.

The eyelids are also a common source of symptoms induced by allergies. These symptoms can be itching, stinging, and/or burning. Most persons with these symptoms respond by vigorously rubbing the eyelids. This can cause mechanical damage to the eyelid skin, from minor trauma resulting in sloughing of portions of the protective stratum corneum to major trauma resulting in small tears in the skin. Most of the skin on the body responds by thickening or callousing when rubbed. Eyelid skin will also thicken, but this predisposes to decreased functioning and worsening of the symptoms.

Eyelids are also a common site for cosmetic adornment. There are more individual colored cosmetics for the eyelid area than any other body area to include mascara, eyeliner, eye shadow, and eyebrow pencil. These cosmetics and the products used to remove them can be a source of both allergic and irritant contact dermatitis, the next topic of discussion.

Common Dermatologic Disease Considerations

As mentioned previously, the eyelid skin is the most common body site afflicted with irritant and allergic contact dermatitis. Some of this predisposition is due to the thinness of the eyelid skin, but the transitional nature of the tissue is also important. The eyelid bridges the transitional area between the well-keratinized skin of the face and the moist tissue of the conjunctiva that lines the inner eyelid and the eyeball. The moisture from tearing wets the eyelid skin and enhances irritant and allergen penetration. It can also help dissolve any allergen or irritant, possibly enhancing the adverse reaction. The eyes are also uniquely designed to sense substances that might cause vision damage, and thus the eyelids have a heightened immune response. Swelling induced by topical, inhaled, or ingested allergens are frequently seen initially in the eyelids. The thin nature of the skin also allows the swelling, due to tissue edema, to appear more dramatic than on other body areas where the skin is thicker and less mobile.

In addition to irritant and allergic contact dermatitis involving the eyelid skin, there are also eyelid diseases involving the eyelid sebaceous glands found at the base of the eyelash follicular unit. This condition is basically acne of the eyelashes and is found both in adolescents and the elderly. It is treated with oral antibiotics, much like traditional facial acne, but superb eyelid hygiene is necessary to prevent recurrence and the avoidance of oily substances in the eye area that might block the sebaceous gland orifice is mandatory.

A type of dandruff, known as seborrheic blepharitis, can also affect the eyelids. This represents the eyelash equivalent of the seborrheic dermatitis, mentioned earlier, that can affect primarily the scalp and sometimes the folds of the face, such as the skin around the nose and mouth. Seborrheic blepharitis is also caused by fungus; thus, proper eyelash hygiene is the key to control. Most individuals with scaling in the eyelash area will also present with facial and scalp scaling as well, thus necessitating treatment of the entire scalp and face.

The eyelid skin is also uniquely affected by the immune status of the individual. Most persons with inhaled allergies to pollen, fragrance, dust, etc. will complain not only of a runny nose, but also of itchy eyes. The eyelids and the nose both represent areas possessing transitional skin bridging the wet mucosa with the traditional dry keratinized skin. Since the wet mucosa is devoid of a skin barrier to allergens and infection, the immune system is particularly fortified in these locations. For this reason, hyperimmune states that affect the overall body skin are keenly present in the eyelid area. The most common of these conditions is known as atopic dermatitis. Atopic dermatitis is a combination of dry skin, asthma, and hay fever. Thus, these individuals have chronic itchy skin, problems breathing, and bad inhaled allergies. One of the most common sites for this condition to manifest is the eyelid. These atopic persons have chronically itchy eyelids that become red, swollen, and tender. They represent a unique population of sensitive eyelid persons that have problems with many eye area cosmetics and skin care products. Treatment of these individuals usually involves the use of high-potency topical corticosteroids and oral antihistamines.

By far the most common dermatologic disease to afflict the eyelid is eczema, more commonly known as bad dry skin. Since the eyelid is relatively poor in oil glands, dry

eyelid skin is frequently seen due to over-aggressive removal of lipids. This may be due to the use of a strong cleanser or products designed to solubilize oil-based waterproof cosmetics, such as mascara and eyeliner. Anything that damages the intercellular lipids or the corneocytes will result in eyelid eczema. Thus, eyelid hygiene must achieve a careful balance between the removal of excess sebum and old cosmetics to prevent eyelash infections and seborrheic blepharitis, while preventing damage to the intercellular lipids and ensuing eyelid eczema.

Hygiene Needs

Cleansing of the eyelid tissue is indeed a delicate task. Typically, the skin should be handled very gently, due to its thin nature, and cleansing should remove excess sebum while preserving the intercellular lipids. If more aggressive cleansing is required, an appropriate moisturizer must be selected that will provide an environment for healing while the intercellular lipids are resynthesized. The typical cleanser used in the eye area by dermatologists is baby shampoo. This non-stinging shampoo formula allows cleansing of the eyelashes to prevent seborrheic blepharitis, while minimizing further eyelid irritation. Typically, the cleanser is applied with the fingertips and not a washcloth or other cleansing implement, since the fingers can easily sense if too much pressure or force is being used to clean the thin eyelid tissue. Most of the diseases of the eyelid and the eye itself are related to poor eye area hygiene and the onset of infection. Thus, appropriate eyelid hygiene is medically and cosmetically important.

Skin Care Needs

After maintaining good eyelid hygiene through proper cleansing, the issues of moisturization and sun protection must be addressed. These are the skin care needs of the eyelid skin. The recurring theme throughout this discussion of the eyelid has been the unique thinness of the skin. This consideration becomes extremely important when formulating eyelid moisturizers and sunscreens. Any eyelid moisturizer selected must spread easily to prevent bruising or tearing. Thus, highly lubricious emollient formulations are best. They should occlude the eyelid skin enough to allow the skin barrier to repair, but should not be too oily such that they interfere with vision if accidentally introduced into the eye.

The thinness of the eyelid skin also makes the use of sunscreens important. UVA radiation can easily penetrate to the dermis of the thin eyelid skin, causing premature wrinkling. The eyelids are also a common site for UVB-induced sunburn. This makes UVA and UVB broad spectrum sun protection vital, a topic more fully discussed in Chapter 9. It should come as no surprise that most men and women notice aging first in the upper and lower eyelid tissue. This thin skin quickly loses elasticity from photodamage, which can be exaggerated by familial tendencies toward eyelid skin laxity, a condition known as blepharochalasis. Eyelid sunscreens must be carefully formulated to avoid allergic and irritant contact dermatitis, stinging, and burning should the product enter the eye, and limited photoprotection. In addition to sunscreens, excellent eyelid skin protection can be obtained through the use of sunglasses and hats.

Lips

The lips present many of the same challenges as discussed previously for the eyes. They both represent transitional skin between traditional keratinized dry skin and moist mucosal skin and they both are portals of entry for foreign invaders, such as bacteria and

viruses, and other substances entering the body, such as medications. However, the lips are much more complex in terms of the substances they contact, since the lips are instrumental in eating. They contact many different foods, chemicals, and cosmetics. They are also in constant motion, much more so than any other part of the body, due to their participation in the phonation associated with speech. Yet, their cosmetic value cannot be minimized. They are an instrument of affection as delivered by a kiss and the focal point of the face. Much poetry has been written about beautiful ruby red lips through the ages.

Anatomy and Physiology

The lips must sustain pulling, twisting, and contracting forces in many different directions in order to eat and speak. To accomplish this engineering feat, they contain a transitional skin surface, known as the vermilion, overlying a complex array of muscles with supporting fat. The vermilion is the portion of the lip that is visible and adorned by lip cosmetics. It has a rich vascular supply that is visible through the thin overlying skin. The lip skin is unique in that it does not have a well-developed stratum corneum making it different than the rest of opaque facial skin. Damage to the lip tissue, from sun or cigarette heat, results in formation of a dysfunctional stratum corneum that causes the lips to lose their characteristic red color. This causes a whitening of the lips, medically known as leukoplakia, literally translated as white plaque.

As the lips age, they begin to thin and lose their characteristic shape. This is due to loss of the fat that gives the lip substance. A profile view of a child will reveal lips that protrude from the face, while the profile of a 70-year-old woman will reveal lips that are flat and even depressed from the facial surface. Many of the new cosmetic fillers, such as hyaluronic acid, are designed to replace this lost fat. The loss of lip shape is also accentuated by loss of teeth and bony gum structures that give the lips their characteristic Cupid's bow shape. The lip muscles remain intact throughout life, but cannot make up for the loss of the underlying fat suspended over a bony frame.

Common Dermatologic Disease Conditions

The lips not only are subject to the effects of aging, but also to the insults of dermatologic disease. Infection is probably the most common serious lip problem. This is typically due to the herpes simplex type 1 virus that is responsible for fever blisters. This infection is seen as a group of clustered tiny blisters, known as vesicles, at the margin of the red vermilion. The herpes simplex virus is usually contracted during youth and remains dormant under the watchful eye of the immune system until reactivated and allowed to migrate from the nerve root to the skin surface. The virus reactivates when the immune system is overburdened. This most commonly occurs when the body is sick with another infection, hence the name "fever blister" for the herpes infection. When the body is busy fighting an infection war at another location, the herpes virus takes the opportunity to reproduce and migrate to the lip causing further pain and misery. The fever blister is contagious during the time when the blisters are filled with liquid. Once a scab has formed over the blister, the infection is no longer transmissible. This is important to the cosmetic industry, since shared lip balms and lipsticks can transmit the virus as long as the blister fluid remains moist. Herpes simplex infections are usually treated with antiviral drugs, such as acyclovir, that stop the virus from reproducing, but unfortunately cannot eradicate the virus from the body. For this reason, fever blisters are recurrent.

The lip is also the site of other infections, such as those caused by yeast. Yeast organisms may be present in the mouth and can migrate to the lips under certain

conditions. Yeast most commonly infects the corners of the mouth, a condition known as perleche. The corners of the mouth are a frequent site of saliva collection, especially in children who drool, adolescents with braces, and the elderly with poor dentition. The moisture remains in the mouth corners overnight, creating a condition known as maceration, and provides a perfect environment for the growth of yeast. Yeast typically is not transferred person to person like the herpes virus previously discussed, but can be a source of pain when cosmetics are applied or a complication of chapped-appearing lips. Perleche is usually treated with a combination of topical low potency corticosteroids and topical antifungal/antiyeast creams.

The last common lip disease to be discussed is chelitis, which simply means inflammation of the lips. Chelitis can be due to chapped lips, a condition akin to dry skin. This can result from insufficient oil being produced by the tiny yellow oil glands lining the edge of the vermillion border, as seen in elderly individuals, or due to chronic wetting and drying of the lips from lip licking, as seen in children. Both of these conditions can be remedied by the use of lip balms, lip moisturizers, or lip sticks. Good occlusion is typically required to allow these conditions to resolve, achieved through the use of oily substances, such as petrolatum, waxes, and silicones. Some elderly individuals may appear to have chronic chelitis or chapped lips due to the continual presence of peeling skin over the lips. This may be due to dryness, but may also be due to insufficient exfoliation of the lip surface or another condition known as actinic chelitis.

Actinic chelitis presents as whitish lips with unrelenting skin scale. The word “actinic” means sun. The dry skin can be removed, but is quickly replaced by the lip renewal process that is unable to make quality smooth skin. Instead, the lip is replaced every two weeks by skin made by cells containing sun damaged DNA. Actinic chelitis is a precancerous condition that can possibly culminate in skin cancer after years of neglect. Actinic chelitis is cosmetically unattractive, since the lips lose their distinct outline and red color, and is best prevented through the use of sunscreen-containing lip balms and opaque lipsticks.

Hygiene Needs

From the preceding discussion, it is apparent that the lips have some unique hygiene needs, because they are the gatekeeper of everything that is consumed orally. Typically, the lips are washed with the face, but they are regularly cleansed with saliva. They are most frequently infected by direct contact with other infected individuals through kissing. Infection that enters the body through the mouth via hand/oral transmission is far more common than infection of the lips themselves.

Skin Care Needs

The best method for keeping the lips infection free is to maintain the vermillion intact, free of fissures or openings. This requires the use of waxy, thick moisturizers designed to stay on the lips through saliva and food contact. The tiny yellow sebaceous glands that can be seen along the edge of the lips in elderly individuals do not function as abundantly with advancing age. Dry lips are also more common in the elderly due to nasal obstruction promoting mouth breathing and dentures that may not fit properly. Dry lips may also be seen at the other end of the spectrum in children who are endentulous or thumb suckers. Occlusive lip balms that prevent saliva from repeatedly wetting the skin surface are the most successful at alleviating the dry skin.

Lip balms can be further adapted to provide both lip moisturization and sun protection. A quality lip balm used on a daily basis with an SPF of at least 15 can prevent

actinic cheilitis, a medically and cosmetically significant condition. A sunscreen-containing lip balm is also the best way to prevent the recurrence of a herpes simplex fever blister, since the virus is photo-reactivated. Lastly, sunscreen-containing lip balms can prevent skin cancer of the lip, a serious medical condition.

Hands

The hands are one of the most expressive parts of the body, providing the structures needed to write, draw, paint, dance, and express affection. It is frequently said that much can be said about people from their handshake, which is an assessment of the skin, muscle, and bone that form the hand. The hand can express gender, occupation, and age. Female hands are small while male hands are large and muscular. People who work with their hands outdoors have a much different skin feel than persons who type on a computer for much of the day. Children have soft, doughy, padded hands while the elderly have thin, sinewy, bony, arthritic hands. Hands are what make humans unique from every other living thing on the earth.

Anatomy and Physiology

The hands are formed of many tiny muscles and bones that account for their agility. They are that part of the body that most frequently touches the outside world and can serve as a vector, bringing infection to the vulnerable nose, eye, and mouth tissues. The hands also sustain considerable chemical and physical trauma. They are washed more than any other body area, yet are completely devoid of oil glands on the palmar surface.

While the stratum corneum of the palm is uniquely designed to withstand physical trauma, it is not designed to function optimally when wet. Water destroys the resistive physical strength of the palmar skin, which is why hand blisters are more common when the hand is perspiring heavily. The palmar surface of the hand has numerous sweat glands, known as eccrine glands, which are largely under emotional control. Palm sweating may occur in warm weather, but may also occur under stressful conditions.

The hand responds to trauma by forming thickened skin, known as a callus. Calluses are formed from retained layers of keratin that form a dead skin pad over the area subjected to repeated physical trauma. For example, the palm of the hand will callus to protect the small bones in persons who use a hammer. The finger will callus in the location where a pencil is held in both children and adults. While the body forms a callus to protect underlying tender tissues, the callus can also cause dermatologic problems. Since a callus is made of retained keratin, it is dehydrated and inflexible and will fissure readily with trauma. Once the keratin is fissured, it cannot be repaired, since the callus is nonliving. This leads to a discussion of the most common dermatologic disease considerations involving the hand.

Common Dermatologic Disease Considerations

Dermatologic disease needs to be divided into those conditions that affect the dorsum or back of the hand and those that affect the palm of the hand. This is an important distinction because the two skin surfaces are quite different. The dorsum of the hand is thinner skin that becomes increasingly thinner with age. After the face, the back of the hand is generally the most photoaged skin location. The skin of the hand loses its dermal strength early leading to decreased skin elasticity, which can be simply measured by pinching the skin on the back of the hand and watching for the amount of time it takes for the skin to

rebound to its original conformation. This easy to perform test is an excellent measure of the hand skin age. Skin that takes a long time to return to normal configuration is more photoaged than youthful skin that bounces back energetically. In addition to losing elasticity, photoaged skin also becomes irregularly pigmented leading to dark areas, known as lentigenes, and light areas, known as idiopathic guttate hypomelanosis. This irregular pigmentation is also accompanied by skin that is easily injured. Injury may be seen in the form of red bruises, affectionately named senile purpura, and tissue tears from minimal trauma, which heal with unattractive white scars.

The palm of the hand is affected uniquely by inflammatory conditions like eczema and palmar psoriasis. Because the palm is the surface that the body uses to pick and touch, it more commonly is affected by chemical and physical trauma. This trauma may manifest as hand eczema, which is usually treated with high potency corticosteroids. In addition, highly occlusive and emollient hand creams are necessary to rehydrate damaged keratin and create an optimal environment for barrier repair. Hand creams are also important in the treatment of psoriasis where too much poor quality skin is produced too quickly. Both of these conditions require carefully selected cleansers and moisturizers, in addition to prescription therapy.

Lastly, the palms can be affected by excessive sweating, a condition medically known as hyperhidrosis. Palmar hyperhidrosis can be physically disabling to persons such that they cannot hold a pen to write or emotionally disabling such that they are uncomfortable shaking hands. As mentioned previously, the eccrine sweat glands on the palms are under temperature and emotional control. Palmar hyperhidrosis is usually more of an emotional condition, since the sweat released by the hands does little to cool the body. The treatment of hyperhidrosis is addressed in Chapter 8.

Hygiene Needs

The hands receive more cleansing than any other part of the body. The basic ritual of “wash your hands before you eat” is an effective method of preventing disease transmission, but may take its toll on the physiologically sebum-lacking skin of the palms. Excessive hand washing can even be considered a medical disease, especially in persons with obsessive-compulsive disorder. There are a variety of methods of washing the hands. Basic hand washing is usually performed with a bar or liquid soap followed by water rinsing. Regimented timed hand washing routines are used to thoroughly remove all bacteria from the hands prior to surgery. Lastly, a variety of hand cleansing antibacterial gels have been introduced, usually based on triclosan, that can be used without water to clean the hands. In general, it is felt that the physical rubbing of the hands to lather the cleanser followed by rubbing in a running stream of water to rinse away the cleanser is important. Both the physical rubbing of the hands and the chemical interaction of the cleanser and water are necessary for optimal hand hygiene.

Skin Care Needs

The skin care needs of the hands go beyond basic cleansing to moisturization, healing, photoprotection, and skin lightening. As mentioned previously, hand moisturization is very important due to frequent cleansing. Hand moisturizers should be designed to occlude the skin reducing transepidermal water loss, rehydrate the skin through the use of humectants, alleviate itch and pain, and smooth the skin surface with emollients. Hand moisturizers with this type of construction can be used for simple dry skin, as well as providing healing qualities for the dermatologic conditions previously discussed.

In addition to moisturization, the hands also need photoprotection both during sports and while driving a car, since photoaging UVA radiation passes through the windshield of a car. Sun protection is a unique challenge for the hands because they are frequently aggressively washed, removing the sunscreen. However, the need for sun protection is obvious when one considers the thin dyspigmented skin that characterizes mature hands. This means that the hands require aggressive anti-aging therapy, discussed in Chapter 11, and skin lightening, discussed in Chapters 13, 14.

Feet

The hands and the feet have much in common. They both have a different type of epithelium on the dorsal and plantar surface, they both have hair on the dorsal surface and none on the plantar surface, and they both have few sebaceous glands and numerous sweat glands on the plantar surface. However, there are many differences between the hands and the feet, the most important being that the feet constantly bear the weight of the body while the hands do not. The feet are used for locomotion, competitive athletics, and personal expression in the form of dance. They are forced into shoes that can function both as protection while walking and the source of bony deformity. One only need look at the bunions and overlapping toes of the woman who wore tall, spiked heel, pointed toe shoes during her youth who cannot walk normally today due to misshapen feet that cannot properly bear weight.

Anatomy of Physiology

The feet form our most important point of contact between the body and the earth. They grow proportionately as we grow during adolescence, pregnancy, and old age to provide the body with stable balance. Unfortunately, their bones wear out with continued use and chronic inflammation to yield crippling arthritis. The sole of the foot is made of keratin remarkably resistant to trauma from torque and pressure, but this resiliency is decreased when the keratin is wet. This most commonly occurs in individuals with sweaty feet. The interaction of sweat with the plantar keratin in the environment of the shoe creates unique hygiene challenges. The lack of oil glands on the sole of the foot also predisposes it to dry skin. This leads to our next topic of discussion, which is dermatologic disease of the feet.

Common Dermatologic Disease Considerations

As might be expected, the warm, moist, dark environment of the foot in the shoe is perfect for infection of all types, especially between the toes. The foot is a common site for bacterial, fungal, and yeast infections. These organisms can live on the surface of the foot or enter into the body through small wounds. Foot infection is a major medical issue in diabetics who have a reduced capacity to fight infection, poor blood circulation to the feet, and reduced sensation. In normal individuals, the most common infection of the feet is fungal, a condition known as tinea pedis. Tinea is the medical word for fungal infections of all types with pedis referring to the feet. Tinea pedis most commonly occurs between the toes, especially between the fourth and fifth toes, since these toes are usually closely spaced. Mild infections of this type can occur in otherwise healthy athletic individuals; however, the incidence of fungal infection increases with advancing age due to deterioration of the body's immune system. Most fungal infections of the toes or the sole of the foot can be easily treated with two weeks of a topical antifungal. However, fungal infections of the nail require oral medication, usually for three months.

The foot is also the site of frequent viral infections in the form of plantar warts. The highly infectious human papilloma virus causes warts. This virus only affects humans, thus warts are passed by person-to-person contact through wounds in the foot. Common places to contract warts include public pools, exercise facilities, dance studios, public showers, etc., basically any place where there is moisture and lots of bare feet.

Other noninfectious growths that occur on the foot include calluses and corns. Calluses form over areas of the feet that are commonly traumatized, such as the side of the great toe, the side of the little toe, and the heel. Corns, on the other hand, occur over bony prominences. Hard corns occur on the sole of the foot at the base of the toes while soft corns occur over bones between the toes. Both calluses and corns are deposits of excess keratin designed to protect the foot from undue injury while walking. Unfortunately, the calluses and corns themselves may produce pain while walking. Substances can be applied to the growths to remove the keratin, but the callus or corn will return unless the exact cause for their formation has been determined. This can be ill-fitting shoes, arthritic changes, or improper weight transfer over the foot while walking.

The foot is also a common site for eczema or dry skin due to the complete lack of oil glands on the sole and the reduced number of oil glands on the top of the foot. The feet receive the most cleanser and water contact of any part of the body while showering, thus excessive removal of sebum on the feet is common. For all of the reasons put forth here, the feet have unique hygiene needs to balance the predilection for infection with the dryness of overcleansing.

Hygiene Needs

The feet need aggressive hygiene, not only to prevent infection, but also to control odor. Foot odor is primarily due to the mixture of sweat with bacteria in the closed environment of the shoe. Bacteria digest the sweat to obtain nutrition and reproduce. Most individuals have several types of bacteria present in low numbers on the feet. The difference between individuals with minimal foot odor and extreme foot malodor is the number and type of bacteria present on the feet. Foot malodor is a much greater problem in persons with hyperhidrosis. Hyperhidrosis of the feet is identical in cause to hyperhidrosis of the palms, in that both are primarily under emotional control, although feet tend to sweat more for thermoregulatory purposes due to the presence of warm socks and shoes.

Good cleansing of the feet is a prerequisite to skin health, but overly aggressive cleansing may set the stage for dry skin and foot eczema. Thus, foot cleansing must be carefully balanced with proper moisturization, our next topic of discussion.

Skin Care Needs

One way to minimize the dryness that may be associated with foot cleansing is through the use of moisturizers. Moisturizers can be used to prevent foot dryness and soften calluses utilizing substances such as urea and lactic acid to open up water binding sites on dehydrated keratin. The physical act of rubbing a moisturizer on the feet can also help desquamate dead skin that may build up between the toes and on the arch of the foot, especially in elderly individuals. Foot moisturizers must be similar to hand moisturizers in that both occlusive and humectant substances must be incorporated.

Nails and Cuticles

No discussion of the hands and feet would be complete without consideration of the nails and cuticles. Even though the nails are made of nonliving keratin, they are the source of

considerable cosmetic attention. Manicures, pedicures, artificial nails, nail polish application, etc. are all popular activities. Certainly, the nails add glamour and enhance the appearance of the hands and feet. In certain cultures, the fingernails are used to designate class status. For example, Greek males allow their little fingernail to grow longer than the rest to show that they work at a desk job rather than performing manual labor, since a long little fingernail cannot be maintained if people use their hands to make a living. Similarly, women in United States use long nails for much the same purpose. Since the nails are made of nonliving tissue, their cosmetic needs are much different than any of the other body areas previously discussed.

Anatomy and Physiology

The nail is a thin plate of nonliving keratin designed to protect the tip of the finger and toes. The nail is produced by a group of cells designated as the nail matrix that lies approximately one-quarter inch below the visible nail. The nail matrix cells are formed at birth and cannot regenerate following injury. For this reason, trauma to the nail matrix can result in a permanently deformed nail that cannot repair and will not grow normally. One of the most important structures adjoining the nail from a dermatologic standpoint is the cuticle. The cuticle is like a rubber gasket forming a watertight seal between the nonliving nail and the skin of the fingertip. Damage to the cuticle results in water, chemicals, or anything the hand touches reaching the nail matrix cells. It is for this reason that dermatologists recommend that the cuticle not be dislodged, pushed back, trimmed, or manipulated in any way. Many of the abnormalities and diseases of the nail tissue can be traced back to a damaged cuticle.

Common Dermatologic Disease Considerations

Nail abnormalities and disease are extremely hard to treat because the visible nail cannot be repaired; only the growth of new nail can be influenced. In most individuals, it takes six months to grow a new fingernail and one year to grow a new toenail. This means that creation of a new nail to replace a damaged nail is a long process requiring patience before the effects of successful treatment are visible. The common nail problem is loosening of the nail plate from the nail bed, a condition known as onycholysis. Onycholysis is usually traumatic in nature and is more common in individuals who wear artificial nails in the form of sculptures or tips. The bond between the artificial nail and the natural nail is stronger than the bond between the natural nail and the underlying skin. This means that the natural nail plate will rip from the skin causing pain and swelling of the finger. The natural nail now appears white, because the nail is no longer attached to the pink flesh, and a space is created beneath the nail plate and the skin where infection can occur. Onycholysis is the most common condition predating a nail fungal infection.

Fungal infections of the nail, medically known as tinea unguinum, are extremely common with advancing age. It is estimated that 80% of persons age 80 or older will develop a nail fungal infection. The infection becomes more common with advancing age as the immune system's ability to protect against a fungal invader is diminished. The same fungus that causes infection of the feet also causes nail fungus, as mentioned previously during our discussion of foot diseases. Nail fungal infections of the hands and feet are very difficult to treat since medication cannot be administered to the nonliving nail. The site of the nail fungal infection is not actually the nail itself, but the living tissues beneath the nail. This makes topical treatment minimally effective because any topically applied medication must penetrate the hard nail plate to reach the infected tissues below. For this reason, fungal nail infections are traditionally treated orally with medications that

must be taken for three months. The oral medication allows an antifungal to be incorporated into the newly grown nail, forming a barrier for the advancing fungal infection. The old infected nail is then cut away to physically remove the infected nail plate, and eventually the treated nail, resistant to fungal invasion, is formed. However, the nail containing the oral antifungal medication is removed with further nail growth and reinfection commonly occurs.

Nail fungus is actually transmitted through fungal spores which are extremely resistant to destruction. Traditional disinfectants used to clean manicure and pedicure instruments are ineffective against the spores, thus fungal disease can be transmitted through nail salons. Nail fungus is also not susceptible to triclosan or other antibacterial agents traditionally used in soaps and cleansers. Thus, the best protection against a nail fungus infection is an intact nail and surrounding cuticle.

Another common nail problem is peeling and cracking of the nail plate. While these are largely cosmetic concerns, they can result in pain and leave the nail weakened to infection. Nail peeling and cracking are more common with advancing age. This may be due to decreased blood flow to the cells of the nail matrix from arthritis or blood vessel disease or due to declining nutritional intake. The body certainly recognizes that the nails are not essential to maintain life, thus under times of stress or illness nail growth is not optimal. However, there are conditions where nutrients may not be absorbed from the intestinal tract that becomes more common with advancing age. One of these nutrients is biotin. Biotin is necessary for hard nails and may not be properly absorbed. For this reason, one of the main treatments for peeling, cracking nails is an oral biotin supplement. Nail dehydration may contribute as well, but this topic is addressed under skin and nail care needs.

There are a variety of inherited or acquired nail deformities for which no treatment exists. For this reason, many dermatologists run the other way when a patient presents with nail problems. Probably the common somewhat treatable nail deformity is psoriasis. As we discussed previously, psoriasis is the production of too much poor quality skin too quickly. Psoriasis of the nail is similar in that the nail that is produced is also poor quality such that little chunks of the nail plate fall out leaving tiny holes or pits. Thus, the hallmark of nail psoriasis is pitted nails. The nails improve slowly as the body psoriasis improves, but methods of camouflaging the problem with nail polish or artificial nails are a more rapid solution. Most dermatologic nail conditions are best treated in the short term with cosmetic techniques, which are beyond the scope of this text.

Hygiene Needs

As mentioned previously, the most important way to keep the nail plate healthy is to leave the cuticle undisturbed. For some, this answer is almost too simple. The nail is designed to take care of itself, and any manipulation interferes with the perfect design. Typically, hand hygiene and nail hygiene are taken care of simultaneously with good hand washing.

The most common infection that affects the nail is known as a paronychia. A paronychia is actually an infection of the skin surrounding the nail to include the cuticle. Here the cuticle is disrupted and water enters the tissue around the nail. This forms a warm, dark, moist space perfect for the growth of yeast organisms. The yeast breakdown the skin and make an environment appropriate for bacterial infection, which occurs secondarily. The bacteria then multiply and produce pain and pus. Use of antibacterial cleansers containing triclosan are very helpful in preventing a paronychial infection along with good moisturization of the tissues around the nail to prevent cracking. Oral antibiotics are usually required to treat nail and cuticle infections of this type.

Skin and Nail Care Needs

Moisturizing the nail and the cuticle are important to prevent disease. Usually these structures are moisturized at the same time the hands are moisturized, but there are some key differences to consider. The outer stratum corneum layer of the skin of the hands is replaced every two weeks, but the nails are nonliving, thus, any dehydration damage inflicted is permanent. Remoisturizing the nails can be minimally enhanced with urea and lactic acid, which increase the water binding sites on the nail keratin, but their effect is temporary until the next hand washing. Also, too much urea and lactic acid can over soften the nail plate, making it more susceptible to fracture. Water is the main plasticizer of the nail plate and it should not be removed with aggressive cleansing.

Scalp

The scalp/hair interface is very similar to the nail/cuticle interface in many respects. Here the nonliving hair abuts the living scalp, just like the nonliving nail abuts the living cuticle. The skin needs of the scalp are complex due to the presence of abundant sweat, sebum, and nerves all complicated by the presence of numerous hair follicles. It is beyond the scope of this text to deal with the many issues surrounding hair growth and cleansing, thus this section will focus strictly on the skin forming the scalp.

Anatomy and Physiology

It is important to recognize that healthy hair begins with a healthy scalp. The hair grows actually below the skin of the scalp with follicles protected in the subcutaneous fat covering the skull. The scalp has an abundant blood supply to provide the necessary nutrients for hair growth and an extensive nerve network. This is why injuries to the scalp bleed profusely and are quite painful. In addition to blood vessels and nerves, the scalp also has numerous eccrine sweat glands and sebaceous glands. These secretions provide nutrients for bacteria and fungus that can infect the skin of the scalp. The hair also increases the chances for infection by providing abundant surface area for organisms to grow. Lastly, sweat can function as an irritant, accounting for the frequent itching associated with areas of sweat collection, such as the nape of the neck. The presence of the neural network around the hairs also provides more opportunities for sensation of itch to be induced.

Common Dermatologic Disease Considerations

The scalp is the site of many dermatologic diseases, the most common of which is dandruff. Dandruff lies on a spectrum between occasional mild flaking of the scalp to thick oozing plaques devoid of hair, known as seborrheic dermatitis. Both of the conditions are caused by the same fungal organism named *Malassezia globosa*. This fungal organism is present in the air and lands on the scalp rich in sebum. It consumes the sebum and leaves behind free fatty acids that are extremely irritating to the scalp skin. These free fatty acids induce itching, inflammation, and increase the scalp skin turnover resulting in flaking. If the immune system is intact, the body will not allow the *Malassezia* to proliferate and the skin remains healthy. If the immune system is not intact, such as with advancing age, the presence of illness, or human immunodeficiency virus (HIV) infection, the *Malassezia* organisms will multiply and their sheer number will induce an infection. A mild infection may be perceived as dandruff, but a more severe infection is termed seborrheic dermatitis. The key to preventing a *Malassezia*

scalp infection is the use of topical antifungals in the form of shampoos containing zinc pyrithione or selenium sulfide or ketoconazole. Active infection can be treated with prescription oral and/or topical antifungals.

It should be mentioned that other fungal organisms, besides *Malassezia*, could also infect the scalp. These include the same fungal organisms that cause athlete's foot (*tinea pedis*) and nail fungal infections (*tinea unguinum*). Fungal infections of the scalp, medically known as *tinea capitis*, are commonly termed ringworm. A worm is not involved, but the areas of hair loss are round, hence the early misnomer that a round worm was causing the problem. The organisms that cause scalp fungal infections can be transmitted person to person on combs or through direct contact. For this reason, *tinea capitis* is mainly seen in children. It is a highly contagious infection requiring the use of oral prescription antifungal medication for eradication.

Bacteria can also affect the scalp creating an infection known as folliculitis. In this condition, the bacteria enter the scalp at the site where the hair exits the scalp, known as the follicular ostia. This is the weakest point of the scalp to infection, since the hair slightly tents the scalp, allowing this skin to sit above the rest of the scalp. When the scalp is scratched, the skin around the hair is preferentially injured and bacteria from beneath the fingernail placed in the scalp skin causes infection. As might be expected, folliculitis is a common complication of an itchy scalp. Folliculitis is usually treated with shampooing for good scalp hygiene, treatment of the scalp itch with topical corticosteroids, and oral antibiotics for the scalp bacterial infection. Shampoos and scalp products that prevent itch are important for maintenance therapy, since an itchy scalp is usually the initiating factor for scalp folliculitis.

Lastly, no discussion of scalp skin could be complete without the mention of psoriasis. As in all other body areas, psoriasis of the scalp is due to the production of too much poor quality skin too quickly. It presents with severe thick silvery plaques of scalp scale that may interfere with hair growth. It is best treated medically; however, shampoos and scalp solutions containing keratolytics, such as salicylic acid, or anti-inflammatories, such as tar derivatives, are helpful. Antidandruff preparations, as discussed previously, may be helpful since the presence of *Malassezia* may initiate a flare of scalp psoriasis.

Hygiene Needs

The hygiene of the scalp must be maintained while beautifying the hair, which can be a cosmetic challenge. Cleanliness of the scalp is very important to prevent fungal and bacterial infection that can induce subclinical and clinical disease, without overdrying the nonliving hair. It is interesting to note that shaving the hair, which provides a ready surface for infection, can cure many scalp diseases. Certainly, this is not an alternative that would be considered by many!

Skin Care Needs

The skin care needs of the scalp are to remove excess skin scale, loosen shedding hair, and maintain the biofilm of sweat, sebum, and organisms in balance. Many might suggest that the scalp should be moisturized to smooth down the skin scale and allow barrier repair to occur. While this is generally the case in other body areas, this logic does not pertain to the scalp. Skin scale provides a home for the fungal and bacterial organisms and allows sweat and sebum to accumulate on the scalp. Removal of the skin scale is key to scalp skin health.

Neck

The neck is an interesting area of highly mobile skin that provides a transition between the thin skin of the neck and the thicker skin of the upper chest and back. It contains fully mature hairs in the male and thin vellus hairs in the female. It is an important area from a cosmetic standpoint since it is an area affected by shaving in the male, fragrance application in the female, and photodamage in both sexes.

Anatomy and Physiology

The neck skin covers important underlying structures, such as the blood and nerve supply to the head. The neck also contains the cervical spine and numerous muscles allowing the head to move side to side. It is for this reason that the neck is a difficult area cosmetically. It does not heal well from cosmetic surgical or traumatic injuries due to this continuous movement. It is also subject to photodamage, since many forget to wear protective clothing or apply sunscreen to the neck. Most hats do not provide adequate neck protection, thus the neck skin tends to show age more quickly than other body areas.

Common Dermatologic Disease Considerations

The photodamage condition that most commonly affects the neck is known as poikiloderma. Poikiloderma describes the thinned skin present from lost dermal collagen. It resembles chicken skin because the lower dermal oil glands become more visible as little tiny yellow dots. The thinned skin also allows better visualization of the underlying small vessel network creating the “red neck” terminology, used to describe those who work out of doors, such as cowboys. Lastly, poikiloderma describes the irregular pigmentation that results from prolonged photodamage characterized by both lighter and darker areas in almost a lace-like pattern. It is interesting to note that the neck skin beneath the chin is sun protected. For this reason, neck photodamage is almost in the shape of a butterfly being more pronounced on the sides of the neck. The degree of photodamage present on the skin of an individual can be easily determined by comparing the sun protected skin beneath the chin with the appearance of the sun damaged skin on the sides of the neck.

The neck is also the site where women apply fragrance. For this reason, the neck is a common site of fragrance allergy. This allergy can manifest as allergic contact dermatitis, which presents as red skin with little tiny bumps, known as papules, and blisters, known as vesicles. Patch testing fragrances is usually performed to determine the exact cause after treatment with topical corticosteroids. Fragrances can also cause irritant contact dermatitis, which presents as simply red, itchy skin, due to the drying volatile vehicle in the perfume.

Hygiene Needs

The hygiene needs of the neck are similar to the rest of the body. The neck does not contain many oil glands and thus cleansing should be thorough, but not over drying. Probably the most unique hygiene need for the neck area is in males who shave the hair in this location. The neck is a transition area for hair growth between the beard of the face and the body hair of the chest. For this reason, the hair exits the skin in many different directions, which predisposes to inflammation of the hair follicular ostia, more commonly known as razor burn. Severe razor burn accompanied by ingrown hairs in African-American males is known as pseudofolliculitis barbae. In this condition, the curved hair shafts re-enter the skin causing inflammation and infection. It is a difficult condition to treat. Growing a beard

and not shaving obtain the best results, since the long hairs cannot ingrow. The second best option to shave frequently and keep the hairs so short that they cannot ingrow.

Skin Care Needs

The major skin care needs of the neck are good moisturization accompanied by sun protection. The neck receives almost as much sun as the face and is a common site for precancerous and cancerous growths.

Body

The body encompasses all the rest of the skin not previously discussed, except for the skin fold areas. Most notable body areas for discussion are the back, chest, arms, and legs. The skin on the body does not heal as well as the face and neck. The further the skin is away from the face, the poorer the surgical result. This is due to the thicker skin in these locations accompanied by the distance away from the heart and a poorer blood supply.

Anatomy and Physiology

The thickest skin of the body is present on the upper back due to the need to sustain pulling and twisting movements from arm motion. This thick skin does not heal well and is a common site of unsightly scars. The poorest healing parts of the body are the upper chest, upper arms, and upper back where hypertrophic scars (thickened scars) and keloids (scars that extend beyond the boundary of the injury) may form with increased frequency. Oil glands are also reduced in these areas making careful cleanser selection and the use of moisturizers important. One of the itchiest spots on the entire body is at the base of the shoulder blade on the back. It is not quite clear why is this the case; however, this spot is extraordinarily difficult to reach and is a common place where people routinely rub against a doorframe!

The arms and legs form another anatomic area. Both sites possess skin that is designed for movement accompanied by hair growth. The oil glands are more numerous here than on the back and chest, but these are frequent sites of skin dryness in the elderly.

Common Dermatologic Disease Considerations

Most dermatologic diseases affect the body, thus a complete discussion of this topic is beyond the scope of this text. For those who wish additional information, a recommended reading list is presented at the end of the chapter. However, it is worthwhile mentioning that the most common skin disease of the body seen by the dermatologist is dry skin, known as eczema. Why is this the case? The reason can be simply stated as overbathing. Many people feel a need to bathe daily and some twice daily. Bathing the body has become a ritual. Some bathe to relax prior to retiring for the night while others bathe to wake up. Athletically inclined individuals bathe after each exercise session. The elderly, who are otherwise inactive, may bathe frequently as they find the warm water soothing for achy muscles and joints. This excessive amount of cleanser and water contact eventually removes not only the sebum, but also the intercellular lipids, causing dry skin. The skin cracks, exposing tender dermal nerve endings, and itching ensues followed by scratching. This further damages the skin barrier and more itching and more scratching occur. Finally, the skin barrier is in complete disarray and the dermatologic disease of eczema is present. This sequence of events is known as the itch-scratch cycle. Successfully controlling the

eczema depends on stopping the itching, repairing the barrier, and restoring the skin to health.

Hygiene Needs

This means body hygiene is a careful balance between removing enough bacteria to prevent disease and body odor while leaving the skin barrier undamaged. This is indeed quite a challenge. It would be nice to somehow develop a cleanser that could distinguish between sebum and intercellular lipids, removing the former while leaving the latter untouched. This should be the goal of all therapeutic body cleansers.

Skin Care Needs

The desire to bathe frequently has created moisturization as the major skin need of the body. Body moisturizers should create an optimal environment for healing and quell itch, leaving the skin smooth and soft. The moisturizer must function in hairy body areas and leave behind a breathable film that does not prevent sweat from evaporating from the body surface. The construction of moisturizers for this purpose is discussed in Chapter 6.

Underarms

The underarms have been removed from the general body discussion as they represent a unique body area medically known as an intertrigenous site. Intertrigenous sites are body areas where two skin surfaces meet. They include the armpit, beneath the female breasts, and between the upper inner thighs. In persons who are obese, other intertrigenous sites may be present beneath the chin, beneath the abdomen, behind the knees, etc. Intertrigenous sites are characterized by moisture retention, skin movement, and warmth. This environment, as mentioned previously, is perfect for the growth of fungus, yeast, and bacteria, thus the intertrigenous sites are frequent sites of dermatologic disease.

Anatomy and Physiology

The armpit is a particularly interesting intertrigenous site because it combines the aforementioned factors with hair and abundant sweat glands. The armpit contains two types of sweat glands, eccrine and apocrine. Up to this point, the discussion regarding sweat glands has referred to eccrine sweat glands that produce a clear odorless sweat designed to cool the body and prevent overheating. Apocrine sweat glands do not participate in thermoregulation, but rather produce a yellowish scented sweat. Apocrine glands are well developed in skunks and deer, but not so well developed in humans. It is the scented apocrine sweat that interacts with special perfumes to produce a unique smell. It is theorized that babies who cannot see recognize their mother from the unique scent of her apocrine sweat. Indeed, there are abundant apocrine sweat glands around the areola of the breast. Other locations of apocrine sweat glands include the groin, buttocks, and scalp. Apocrine sweat provides a perfect growth media for odor producing bacteria. Further growth of these bacteria, in combination with fungus and yeast, can result in infections seen in the armpit, our next topic of discussion.

Common Dermatologic Disease Considerations

Infection is clearly the most common dermatologic condition seen in the armpits. Infection may be due to fungus, yeast, or bacteria. The most common condition seen in the armpit is known as intertrigo. This is the growth of yeast and possibly fungus in the warm moist

environment of the armpit that has had the skin barrier damaged by overhydration with eccrine sweat. Intertrigo presents as red, inflamed skin that may itch or burn. It is typically treated with a combination of topical antiyeast/antifungals and topical corticosteroid creams. Elimination of the sweat can prevent recurrence through the use of antiperspirants, discussed in Chapter 8.

Bacterial infections of the armpit are usually due to staph or strep organisms. These are the most common pathogens found in the environment and on the body. The apocrine sweat in the armpit provides an excellent bacterial growth media. If the bacterial infection involves the skin of the armpit, it is known as impetigo. If the bacterial infection involves the skin around the exit of the hair from the skin, it is known as folliculitis. Open wounds that may be scabbed or oozing pus characterize both conditions. They are treated with oral and/or topical antibiotics. Again, elimination of the sweat is key to prevention.

Hygiene Needs

It comes as no surprise that the key hygiene need in the armpit is the elimination of eccrine and apocrine sweat. Sweating is normal part of human physiology, but excessive sweating may occur in the armpits, just like on the hands and feet, and is characterized as hyperhidrosis. Controlling the sweat prevents body odor, skin barrier damage, infection, and emotionally disturbing wetness. This is the realm of antiperspirants, but oral medications and chemodenervation through botulinum toxin A are also used. These topics are more fully explored in Chapter 8.

Skin Care Needs

The skin care needs of the armpit are mainly irritation reduction from the aluminum salts used in antiperspirants and hair removal. Unfortunately, most topical antiperspirants cause irritation in the sensitive skin of the armpit. This can result in irritant contact dermatitis, especially if the skin barrier has already been damaged from overhydration. Thus, the best way to maintain the health of the armpit is to use an effective, nonirritating antiperspirant.

The armpit skin barrier may be further irritated from hair removal techniques, especially in the female. The armpit is a challenging area to shave with a razor due to its concave nature. Using a well-designed razor and shaving cream to both soften and reduce friction are key in the armpit. Depilatories are typically too irritating for armpit hair removal. However, hair removal is an important method to control armpit odor, since the hair provides a large surface area for bacterial growth. Removal of the hair limits the amount of bacteria that can be present in the armpit.

Female Genitalia

Our last body areas to discuss are the female and male genitalia. These areas have been separated for individual discussion because they represent unique skin interfaces with important hygiene and skin care needs.

Anatomy and Physiology

The female genitalia forms several skin interfaces. The hair bearing skin of the mons pubis joins the nonhair bearing skin of the labia and the mucosal surface of the labia abuts the urethra and vagina. A further skin interface is created where the keratinized skin of the

inner thigh joins the transitional skin of the anus. Each of these sites form a location where skin disease can occur.

The female genitalia is one of the intertrigenous zones previously discussed and as such is a warm, moist, dark place prone to infection from fungus, yeast, bacteria, and viruses. It is easily irritated and fragile with worsening fragility arising from the mucosal thinning that occurs with menopause.

Common Dermatologic Disease Considerations

The most common dermatologic conditions involving the genitalia would then be infection and irritation. Infection is frequent, since the mucosa presents little barrier to infection. Common infections of the genitalia include herpes simplex, genital warts, yeast (usually *Candida albicans*), and fungus. Fungal infections of the groin, medically known as tinea cruris, occur from the same organism that causes fungal foot and toenail infections.

Irritation in the groin usually arises from tight fitting clothing that does not control moisture. Just like other skin areas, overhydrated skin is easily damaged. Since this is an area of abundant apocrine and eccrine sweat glands accompanied by the wetness of vaginal secretions and urine, hygiene assumes great importance.

Hygiene Needs

Hygiene of the female genitalia is an important, but overlooked, area. Most cleansers that are designed for keratinized body skin do not function well as cleansers for the mucous membranes of the female genitalia. They damage the mucosa causing itching, stinging, and pain. Yet, there is a need for cleansing to prevent infection and control odor.

Skin Care Needs

Thus, the basic skin care need of the female genitalia is the management of wetness without the removal of the natural vaginal lubricants necessary to keep the tissues soft and supple. This is quite a challenge, which has not yet been met. It is desirable to absorb and remove the sweat, but the mucous secretions must remain in place to lubricate the tissues as they glide across one another with walking and movement.

Male Genitalia

The male genitalia also form an interface between various skin types with and without hair. The lack of a large mucosal surface makes infection less of a problem, but the presence of hair is a complicating factor.

Anatomy and Physiology

The male genitalia is characterized by the thin skin of the scrotum interfacing with the keratinized skin of the penis abutting the transitional mucosal skin of the head of the penis. In uncircumcised males, the head of the penis and the part of the penis beneath the foreskin is true mucosa. This true mucosa is a common site of infection, but is not found in the circumcised male.

Common Dermatologic Disease Considerations

The most common dermatologic disease seen in the male is known as “jock itch.” It represents a fungal infection, medically known as tinea cruris, again due to the same organisms that cause ringworm and toenail infections. The fungus can be passed between partners with direct contact, which is usually how females acquire the infection. Yeast infections of the penis can also occur, but this is less common in the circumcised male. Other infections, such as venereal disease may occur, but this is beyond the scope of this discussion.

Hygiene Needs

The hygiene needs of the male genitalia mainly focus around moisture and body odor control. Both are related because moisture is necessary for the growth of bacteria that cause body odor, thus eliminating wetness solves both problems. No personal antiperspirants exist for the area and moisture-absorbing powders usually become sticky, creating another problem.

Skin Care Needs

The need for skin lubrication does not exist for the male like it does for the female. All of the body surfaces that move with locomotion are keratinized and do not require lubrication.

Summary

This section has presented an overview of cutaneous formulation issues that must be considered when developing successful products for a given body area. Each major body area has been discussed in terms of anatomy and physiology of the anatomic site, common dermatologic disease considerations, hygiene needs, and skin care needs. Yet, there is much more that could be written for the person who wishes further study. This list contains major dermatology textbooks that should be consulted for additional information.

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3

Formulation for Special Populations

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Not all skin is the same. This is one of the key challenges in the treatment of dermatologic disease and successful global cosmetic formulation. The same skin disease can look very different in Caucasian versus African American skin. The pigmentation problems common in Asian skin are not seen in northern Europeans. The effects of aging are much different in men versus women. Adolescents are more likely to develop acne in response to product use than mature individuals. Persons with easy flushing experience stinging and burning in response to product application more frequently. Thus, issues of ethnicity, skin color, age, gender, and skin sensitivity must be considered when formulating skin care products for a global market. This chapter discusses these important formulation issues.

GENDER

Gender difference issues are some of the most basic when considering cosmetic formulation. Male skin is visually much different than female skin and has a unique response to aging and adverse product reactions. When discussing female versus male skin, we shall be talking about fully mature individuals. The unique skin care needs of children will be discussed later.

Probably the most important difference between male and female skin is the skin thickness. Male skin is thicker than female skin, in part due to the presence of terminal hair follicles over much of the body. This difference is most pronounced on the face where women have only vellus hairs while men have fully developed terminal hairs taking up space within the skin. The presence of male facial hair is partially responsible for the more favorable appearance of mature men over mature women. As UV radiation activates collagenase to destroy dermal collagen, the male beard allows the skin to resist wrinkling, which is not the case in females. Thus, photoaged males do not exhibit the pronounced redundant facial skin seen in photoaged females. The thicker male skin is also better at diffusing UV radiation, especially in the UVA range, which penetrates more deeply causing greater damage in female skin. The media that tends to prefer images of younger women and older men further magnifies the gender differences in photoaging.

Differences in skin thickness also impact the frequency of adverse product reactions suffered by the two sexes. Women experience adverse reactions more commonly than men. The thinner skin may allow irritants and allergens to penetrate deeper in female skin, but the increased incidence may also be due to greater product usage. Women overall use more skin care products and cosmetics than men. This increased usage magnifies the chances of contacting an irritant or an allergen. Women are also more likely to undergo procedures that destroy the skin barrier, such as facial peels, microdermabrasion, spa treatments, etc. Furthermore, women are more likely to engage in anti-aging topical products that can create barrier damage, such as topical tretinoin, glycolic acid, lactic acid, etc. This damage to the stratum corneum further increases the chance for magnification of a mild adverse reaction into a more major problem. This artificially created increase in adverse reactions experienced by women has been termed “polypharmacy” by some who wish to impart the concept of overusage of prescription and over-the-counter products by youth-seeking women. Others use the term “iatrogenic sensitive skin” to emphasize the skin sensitivity created by exaggerated product use.

Perhaps one of the most important differences between male and female skin is the relative balance between male testosterone and female estrogen and progesterone. Male and female skin is quite similar up until puberty, at which time sexual differences become more pronounced. Both testosterone and estrogen cause the production of facial and body sebum. This onset of oil production sets the stage for acne whereby the (*Propionibacterium acnes*) bacteria now has a food supply to encourage abundant growth. More sebum production is triggered by testosterone accounting for the generally greater severity of acne in males over females. However, females with higher than normal testosterone production, due to hormonal abnormalities, such as polycystic ovary disease, may experience acne equally severe to any male. The onset of hormones also triggers an increase in apocrine sweat, the scented type of sweat that is produced by specialized sweat glands on the eyelids, breasts, scalp, buttocks, and in the armpits. Both sebum and apocrine sweat create different skin cleansing needs and alter the skin biofilm in ways that can dramatically affect cosmetics and skin care products. The formulator must consider the substances on top of the skin.

AGE ISSUES

In addition to gender issues, age issues are also important to the formulator. Newborn children produce little sebum and eccrine sweat. Sebum production typically does not begin until the hormonal changes of puberty occur, as discussed previously; thus, most children have dry skin. This creates a challenge, since children frequently get their skin dirty, which necessitates washing. The child may not produce enough sebum to combat the effect of cleansing that may remove the intercellular lipids resulting in barrier damage. This creates the need for thorough mild cleansers and moisturizers for children. Careful formulation is essential, since the skin of children is also thin and their well-functioning immune system is likely to respond aggressively to irritants and allergens. It is for this reason that children are considered to have sensitive skin.

Puberty brings full functioning of the sebaceous, apocrine, and eccrine glands. This may be advantageous to dry skinned children who will no longer suffer from eczema. Many times allergies also become attenuated at this age. But, of course, oil, and sweat removal become more of a problem as acne and body odor emerge. The next complexion change generally occurs around age 40 as sebum production begins to decline. There is great variability in the age at which sebum production changes. In women, dramatically

decreased sebum production occurs at menopause, which usually begins by age 50 and is completed by age 60.

Usually about age 60 there is a transition in both men and women to geriatric skin. While this is not a proper medical term, there are unique skin needs of the elderly. These include skin fragility that results in easy skin tears and bruising due to loss of dermal collagen, which confers the skin's strength. Even the rubbing of thick viscous skin creams can cause bruising in elderly skin, medically known as senile purpura. Elderly skin is also unique in that it appears chronically dry, even though noninvasive skin measurements, such as transepidermal water loss, are normal. This may be due to the decreased ability of dead skin scale to slough in a timely manner. The buildup of corneocytes appears like dry skin even though the viable epidermis is well moisturized. This means that moisturizers designed for geriatric skin should encourage desquamation and provide superior emolliency to smooth the dry-appearing corneocytes.

The last area to discuss in elderly skin is itching. Geriatric skin is uniquely itchy, even though there is little visible evidence of barrier disruption. Itching is typically due to barrier disruption, medically termed dermatitis, and lack of protection of underlying dermal nerve endings. In the elderly, severe itching may be reported even though no dermatitis is present. This is a diagnostic enigma for the dermatologist. Skin itching appears to become worse in the postmenopausal female; thus, estrogen may play a role. However, the exact cause of the itching is not always apparent. It may be due to depression, poor dermal support of the nerve endings, abnormal intercellular lipids, etc. Thus, itch reduction is a skin care need in the elderly, not frequently seen in younger populations.

SKIN COLOR

We shall now turn our discussion to skin color. Skin color produces as many variations in skin care needs as age. All colors of skin possess melanin, but the differences arise from how the melanin is packaged within the skin. This difference in melanin packaging gives rise to light and dark skin and also to the skin sunburn characteristics. These topics are covered in more detail in the sunscreen chapter; however, here we shall address the unique differences between skin color and skin care product response. Very light skin that does not tan well typically does not respond to injury with pigmentation problems. There may be some transient hypopigmentation, or reduced skin color, especially with skin dryness where the skin does not tan well, a condition medically known as pityriasis alba. Hypopigmentation may also be seen following a traumatic skin injury, especially if the melanocytes have been damaged. However, a burn injury usually results in increased pigmentation, medically known as post-inflammatory hyperpigmentation. This is in contrast to persons with darker skin, to include Asian, Mediterranean, African American, and Hispanic persons, who experience frequent post-inflammatory hyperpigmentation, which is a larger cosmetic concern than wrinkling in these ethnic groups.

Postinflammatory hyperpigmentation is darkening of the skin in response to injury. The injury can be from acne, sunburn, skin disease, irritant contact dermatitis, allergic contact dermatitis, or a traumatic scratch. Since melanocytes are felt to be an important part of the immune system, it is postulated that this hyperpigmentation is an immune response to skin injury, but the exact reason for this reaction is largely unknown. Thus, products designed for skin of color must be carefully formulated to minimize any skin irritation, since postinflammatory hyperpigmentation is the inevitable result. It may take six months to one year to return the skin to normal color after the injury, which accounts for the tremendous skin lightening product focus in cultures with darker complected

individuals. In order to return the skin to proper color, the extra melanin produced must be phagocytized or consumed by white blood cells and then removed from the skin. More superficial pigmentation can be readily removed while some deeper dermal pigmentation may be permanent.

Skin color also confers photoprotection. Darker skin can sunburn and tan just like fair skin, but deepening of the skin color is generally considered undesirable. This is not the case in fair complected individuals who try to achieve a tan by natural sun exposure, the use of artificial UVA radiation in a tanning booth, or dyeing of the skin with self-tanning products containing dihydroxyacetone. Melanin is basically an unstable radical that can absorb an electron from highly energetic unstable oxygen species, preventing the activation of collagenase and the resulting dermal damage. This is why darker complected persons typically do not demonstrate photoaging to the same degree as their lighter age-matched counterparts.

In addition to the different skin color responses to injury and photoaging, another important reaction pattern, known as follicular predilection, is unique to skin of color. Follicular predilection refers to the presence of disease around the follicle and at the opening of the hair onto the skin surface, known as the follicular ostia. For example, eczema due to dry skin usually occurs evenly over the skin surface in fair complected individuals, but in African American persons, the eczema occurs around the follicular ostia giving the skin a unique goose bump type of appearance. Whether this reaction pattern is due to the increased melanin or the kinky hair is unknown, but this type of eczema is considerably more difficult to treat. Mild skin irritation or full blown irritant contact dermatitis may also be present with this follicular pattern. Thus, problems associated with skin care products or cosmetics may appear differently in skin of color, sometimes confusing the proper diagnosis.

HAIR SHAFT ARCHITECTURE

No discussion of skin is complete without considering the contribution of the hair to the physiology of the skin. Different hair architecture accompanies different skin colors; thus, the hair and the skin are inter-related special considerations. Caucasian persons with very fair skin typically have straight to slightly curly hair while African American persons with dark skin typically have kinky hair; however, many variations exist. Follicular skin problems are usually minimal in Caucasian, Asian, Hispanic, and Mediterranean individuals where the oval to elliptical hair cross-section yields body hair that is straight to curly. Unique follicular problems exist in African American persons where the flattened elliptical hair cross-section yields tightly kinked hair. This tight kink predisposes the hair to ingrowing, especially on the face, in the armpits and groin, and on the legs. Shaving of the hair in any of these areas cuts the hair at an angle and the tight kink of the hair shaft allows the short hair to re-enter the skin after exiting the follicular ostia due to the sharp tip. The ingrown hair then burrows beneath the skin surface causing inflammation, which can result in the formation of a pustule, the appearance of post-inflammatory hyperpigmentation, and/or a scar. When these findings arise in connection with ingrown facial hairs, it is known as pseudofolliculitis barbae.

This means that African American persons can develop skin disease based on the manner in which they groom their body hair. This problem with ingrown hairs explains why many African American women do not shave their armpits, groin, and legs. It also explains why many African American men wear a short beard. The only way to avoid the ingrown hair is to keep the hair so short that it cannot ingrow, which may mean twice daily

shaving for some, or to allow the hair to grow so long that it cannot ingrow, which is much simpler. Depilatories, waxing, and laser hair removal techniques are generally not an option in African American individuals, since these methods do not work well on the deeply pigmented kinky hair shafts.

SENSITIVE SKIN

Probably the biggest formulation challenge for the cosmetic chemist and the biggest treatment challenge for the dermatologist is sensitive skin. Sensitive skin can present with visible outward changes, easily recognized by the dermatologist, or invisible signs with marked symptoms presenting a treatment challenge.

Visible sensitive skin is the easiest condition to diagnose, since the outward manifestations of erythema, desquamation, lichenification, and inflammation identify the presence of a severe barrier defect. Any patient with a barrier defect will possess the signs and symptoms of sensitive skin until complete healing occurs. The three most common causes of barrier defect induced facial sensitive skin are eczema, atopic dermatitis, and rosacea. These three diseases nicely illustrate the three components of sensitive skin, which include barrier disruption, immune hyper-reactivity, and heightened neurosensory response.

Eczema

Eczema is characterized by barrier disruption, which is the most common cause of sensitive skin. The barrier can be disrupted chemically through the use of cleansers and cosmetics that remove intercellular lipids or physically through the use of abrasive substances that induce stratum corneum exfoliation. In some cases, the barrier may be defective due to insufficient sebum production, inadequate intercellular lipids, abnormal keratinocyte organization, etc. The end result is the induction of the inflammatory cascade accompanied by erythema, desquamation, itching, stinging, burning, and possibly pain. The immediate goal of treatment is to stop the inflammation through the use of topical, oral, or injectable corticosteroids, depending on the severity of the eczema and the percent of body surface area involved, and proper skin care products and cosmetics.

Atopic Dermatitis

Sensitive skin due to eczema is predicated only on physical barrier disruption, while the sensitive skin associated with atopic dermatitis is predicated both on a barrier defect and an immune hyper-reactivity, as manifested by the association of asthma and hay fever. Patients with atopic dermatitis not only have sensitive skin on the exterior of the body, but also sensitive mucosa lining the eyes, nose, and lungs. Thus, the treatment of sensitive skin in the atopic population involves topical and systemic considerations. There is also a prominent link between the worsening of hay fever and the onset of skin symptoms, requiring broader treatment considerations.

All of the treatments previously described for eczema also apply to atopic dermatitis, but additional therapy is required to minimize the immune hyper-reactivity. While this may take the form of oral or injectable corticosteroids, antihistamines (hydroxyzine, cetirizine hydrochloride, diphenhydramine, fexofenadine hydrochloride, etc.) are typically added to decrease cutaneous and ocular itching. Antihistamines also improve the symptoms of hay fever and may prevent a flare up should the patient be exposed to pollens or other inhaled allergens. The avoidance of sensitive skin in the atopic patient is largely predicated on avoidance of inciting substances. This means creating an

allergy-free environment by removing old carpet, nonwashable drapes, items likely to collect dust, feather pillows and bedding, stuffed animal toys, heavy pollinating trees and plants, pets, etc. The prevention of the release of histamine is the key to controlling the sensitive skin of atopic dermatitis.

Rosacea

Rosacea is an example of the third component of sensitive skin, which is heightened neurosensory response. This means that patients with rosacea experience stinging and burning to minor irritants more frequently than the general population. For example, I demonstrated that 62.5% of randomly selected rosacea patients demonstrated a positive lactic acid sting test for sensitive skin (1). Furthermore, rapid prolonged facial flushing is one of the main diagnostic criteria for rosacea. Whether this sensitive skin is due to nerve alterations from chronic photodamage, vasomotor instability, altered systemic effects to ingested histamine, or central facial lymphedema is unclear.

The treatments for rosacea-induced sensitive skin are much different than those for eczema or atopic dermatitis. Anti-inflammatories in the form of oral and topical antibiotics form the therapeutic armamentarium. Antibiotics of the tetracycline family are most commonly used orally, while azelaic acid, metronidazole, sulfur, and sodium sulfacetamide are the most popular topical agents. However, the effect of the anti-inflammatory antibiotic can be enhanced through the use of complementary skin care products that enhance barrier function.

Eczema, atopic dermatitis, and rosacea are in some ways the easiest forms of sensitive skin to treat. The skin disease is easily seen and treatment success can be monitored visibly. If the skin looks more normal, generally the symptoms of itching, stinging, burning, and pain will also be improved. Unfortunately, there are some patients who present with sensitive skin and no clinical findings. These patients typically present with a bag full of skin care products they claim cannot be used because they cause facial acne, rashes, and/or discomfort. This situation presents a challenge for the physician, since it is unclear how to proceed.

Several treatment ideas are worth considering. The patient may have subclinical barrier disruption. For this reason, treatment with an appropriate strength topical corticosteroid for two weeks may be advisable. If symptoms improve, then the answer is clear. The patient may have subclinical eczematous disease. If the symptoms do not improve, it is then worthwhile to examine the next most common cause of invisible sensitive skin, which is contact dermatitis. This is accomplished by considering the ideas presented in Table 1 (2). Sometimes a more regimented approach to contact dermatitis is required, as represented by the basic product selection ideas presented in Table 2.

Sensitive skin products are increasing in the marketplace, since many individuals consider themselves to possess sensitive skin while others feel that products labeled for sensitive skin are less likely to cause problems in all populations. Exactly what is unique to sensitive skin products is unclear. In many ways, it is simply a marketing statement; however, some manufacturers will elect to test their formulations on persons with eczema, atopic dermatitis, and rosacea as part of a sensitive skin panel to substantiate the claim.

CONTACT DERMATITIS ISSUES

Our prior discussion of sensitive skin focused on those special skin conditions, namely eczema, atopic dermatitis, and rosacea, which form the basis for a sensitive skin panel. However, we must also consider issues of contact dermatitis. Traditionally, issues of

Table 1 Considerations for the Minimization of Contact Dermatitis from Skin Care Products and Cosmetics

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1. Eliminate common allergens and irritants, or reduce their concentration
 2. Select products from a reputable manufacturer that uses high-quality pure ingredients free of contaminants
 3. Products should be well-preserved to prevent the formation of auto-oxidation byproducts
 4. Paraben preservatives have proven to be the least problematic
 5. Avoid solvents, volatile vehicles, vasodilatory substances, and sensory stimulators in all products
 6. Minimize the use of surfactants and select minimally irritating emulsifier systems
-

irritant contact dermatitis are implied under the claim umbrella of sensitive skin, but allergic contact dermatitis issues are sometimes separately claimed. Allergic contact dermatitis issues may fall under the claim of hypoallergenic. Exactly what hypoallergenic means is unclear. In the strictest sense, the word hypoallergenic is used to indicate reduced allergy. Many products that are labeled hypoallergenic are also labeled as appropriate for sensitive skin, but the claims are somewhat different. All sensitive skin products should be hypoallergenic, but all hypoallergenic products are not necessarily appropriate for sensitive skin. In my mind, hypoallergenic simply means that common allergens have been removed from the formulation, but irritants may still be present.

Formulating products with reduced allergy is sometimes difficult. It is obvious that poison ivy, a common allergen, should never be included as an ingredient, but other guidelines are sometimes difficult to develop. It is probably for this reason that hypoallergenic has never been defined by any regulatory body. Hypoallergenic products are probably best formulated by using the fewest, purest ingredients possible and staying away from unusual botanical extracts. A poor approach would be to put anti-inflammatory substances, such as bisabolol or allantoin, in the formulation to minimize any allergic reaction. A quick review of the contact dermatitis literature shows that the most commonly cited cases of skin care product induced problems arise when contaminated raw materials are used, such as nickel-contaminated eye shadow pigments or oxidized vitamin E, or when product preservatives break down. The best guarantee of formulating a hypoallergenic product is to use time-tested ingredients in a stable formulation.

Table 2 Cosmetic Selection Criteria in Sensitive Skin Patients

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1. Powder cosmetics should be selected
 2. Cosmetics should be water removable
 3. Old cosmetics should be discarded
 4. Eyeliner and mascara should be black
 5. Pencil formulations should be used for eyeliner and eyebrow cosmetics
 6. Eye shadows should be earth-toned (tan, beige, light pink, cream)
 7. Avoid chemical sunscreens in cosmetic formulations
 8. Select cosmetic formulations with as few ingredients as possible
 9. Avoid nail polishes
 10. Select cream/powder facial foundations or, if liquid, silicone-based formulations
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ACNE ISSUES

The last two claims for special populations are non-comedogenic and non-acneogenic. These claims are aimed at individuals who develop acne in response to the facial use of skin care products and cosmetics. Non-comedogenic refers to the testing of products to determine that they do not produce blackheads, known as open comedones, or whiteheads, known as closed comedones, after wearing. Comedogenicity was a much greater problem when petrolatum was contaminated with tar, a known comedogen. Presently, comedogenicity is not a great problem, except in the ethnic hair care market where comedogenic vegetable oils, such as olive oil, are used in pomades to moisturize the hair.

Testing must be done to substantiate the non-comedogenic claim. In the past, comedogenicity was assessed in the rabbit ear assay by applying the final formulation inside a rabbit ear and then visually assessing the presence or absence of comedones. This test was not felt to have much human validity and animal testing has fallen out of favor; thus, the rabbit ear assay has given way to testing on human volunteers. Typically, the final formulation for testing is applied to the upper back in persons capable of forming comedones on the upper back daily for 14 days. A positive control, in the form of tar, is applied, and a negative control, in the form of pure petroleum jelly, is also used. The comedones are extracted from the upper back with cyanoacrylate glue placed on a microscope slide. Any increase in comedone formation following the 14-day exposure to the final cosmetic formulation is considered comedogenic.

The non-acneogenic claim is much different. It implies that the finished product does not produce true acne, which is identified as red bumps, known as papules, or pus bumps, known as pustules. It takes much longer for acne to develop from product use, typically about four weeks. There is no standard test done for acneogenicity, except for use testing. Volunteers use the product as intended for one month and are examined for the presence of papules and pustules. Yet, there are a number of individuals who will develop tiny perifollicular papules and pustules within 48 hours of wearing a skin care product or cosmetic. Is this acne? The answer is no. True acne cannot develop in 48 hours. In my opinion, this is perifollicular irritant contact dermatitis. It looks much like acne, but the presence of lesions at the follicular ostia and the rapid onset lead to the diagnosis of perifollicular contact dermatitis. This problem is best avoided by minimizing the presence of irritants in the formulation as previously discussed.

SUMMARY

Formulating for special populations is indeed a challenge. There are unique dermatologic reaction patterns that must be considered. Failure to consider these reaction patterns could result in a product that is not globally acceptable. The globalization of the cosmetics industry means that skin care and cosmetic products must be suitable for both sexes, all ages, all skin types, all ethnic groups, all skin colors, etc. Understanding the unique needs of all world populations is vital to success.

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