Skin Care for the Sensitive Skin and Rosacea Patient: The Biofilm and New Skin Cleansing Technology

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Skin cleansing is a complex interaction between the skin surface, physical rubbing, and the chemistry of the cleanser. Many dermatologists recognize that cleansing is necessary to maintain skin health, but overly aggressive cleansing is probably the most common source of eczematous skin disease. How does one find the proper balance between hygiene and disease? What should a skin cleanser remove? What should it leave behind? How do the new moisturizing cleansers work? Can a cleanser rinse from the skin while creating a thin film of petrolatum or ceramides? These important questions will form the basis for this article investigating new cleanser technology. Cleansing technology is particularly important in sensitive skin conditions such as rosacea.

The Biofilm

Every surface of the body that encounters the outside world contains a biofilm. Thus, there is a unique regional biofilm on keratinized skin, mucous membrane interfaces, intertrigenous skin, the teeth, the intestines, etc. The biofilm is not sterile, but rather a careful balance between pathogenic and nonpathogenic fungi, yeast, and bacteria. Maintaining this balance is the key to healthy skin. In the past, it was thought that the biofilm should be completely removed from the body; however, it is now well recognized that the biofilm cannot be eliminated, and its destruction may be the initiating event leading to skin disease.

An understanding of the biofilm is perhaps best developed in dentistry. The presence of dental plaque is an example of a biofilm gone awry. Dental plaque is a sticky white substance composed of food debris and dental caries forming bacteria. The bacteria proliferate and release a substance that damages tooth enamel creating decay. The goal of toothpaste is to physically and chemically remove plaque from the tooth surface, decreasing the chance for decay and improving oral hygiene. A variety of antibacterial agents such as triclosan have been added to toothpaste preparations to aid in the control of oral bacteria. This is the same ingredient added to waterless antibacterial hand sanitizers to decrease the bacterial count on the hands.

Alterations in the biofilm are probably most dramatically appreciated in the gastrointestinal tract. Changes to the biofilm occur when oral antibiotics alter the intestinal flora, resulting in flatulence and diarrhea. Concurrent vaginal yeast infections resulting from antibiotics also represent yeast overgrowth in the absence of nonpathogenic bacteria. Health cannot be regained until the infection is eliminated and the natural biofilm restored.

Keratinized skin possesses the most elaborate biofilm of any body site. The biofilm is composed of sebum, eccrine and apocrine secretions, environmental dirt, cosmetics, skin care products, bacteria, yeast, and fungi. Is it possible to eliminate the skin's biofilm? For all practical purposes, it can be diminished but not eliminated. Even after aggressive skin cleansing, the biofilm begins to reappear almost immediately.

The Biofilm and Dermatology

The biofilm is the essence of dermatology. All topical medications mix with the biofilm—either enhancing or decreasing efficacy. For example, sebum can mix with oil-in-water vehicle emulsions, thus destabilizing the emulsion and rendering the medication inactive; sebum can destroy the film-forming characteristics of a sunscreen, decreasing the sun protection factor by 50%.

The biofilm affects our biologic perceptions of the skin. It is commonly felt that the skin should be maintained at

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a slightly acidic to neutral pH of 5 for optimal functioning in the absence of disease. The pH of the biofilm is 5; the skin's pH cannot be accurately measured because it is always covered with a biofilm.

The biofilm affects dermatologic disease. Acne, rosacea, seborrheic dermatitis, and tinea versicolor are all diseases of the biofilm. Acne is due in part to the presence of *Propionibacterium acnes* in the skin's biofilm. Without *P acnes*, there is no acne, and without sebum, there are no *P acnes*. Thus, the presence of sebum in the biofilm allows growth of bacteria-producing free fatty acids and initiates the onset of skin disease. The presence of bacteria, in addition to *Demodex folliculorum*, is thought to be operative in rosacea. Seborrheic dermatitis is caused by the presence of the fungus *Malassezia globosa* on the scalp. The organisms use sebum as a food source, releasing irritating free fatty acids and causing the characteristic sebum-crusted scaling as well as itching. Tinea versicolor is due to an increase in fungal proliferation on the skin surface. If the biofilm were somehow altered, disease would not recur. It is for this reason that antibacterial and antifungal agents are the mainstay of many dermatologic treatments.

Skin Hygiene Versus Disease

Where then is the careful balance between hygiene and disease? Good hygiene mandates that disease-causing bacteria, yeast, and *Candida* organisms are removed from the skin surface. Since antibacterial and antifungal medications are not recommended for daily use, the best method for keeping the growth of pathogenic organisms in check is to remove apocrine sweat and sebum from the skin surface, which eliminates their nutritional source. Following this line of logic, it would then seem advantageous to use the most aggressive degreasing cleanser available on a frequent basis; however, this would also result in disease in the form of eczema. Unfortunately, cleansers cannot distinguish between the lipids found in sebum and the lipids present between the corneocytes in the stratum corneum. Aggressive cleansing normalizes the biofilm but damages the stratum corneum, creating disease of another type.

It is this careful balance between skin hygiene and barrier preservation that presents the greatest challenge for cleanser formulators. The invention of soap ranks along with clean water and public sewers as one of the major health advances in the United States. There are 3 types of traditional cleansers classified as soap: *true soaps*, *syndets*, and *combars*. True soaps, such as Ivory®, are composed of long-chain, fatty-acid, alkali salts with a pH of 9 to 10. These true soaps can alkalinize the skin's biofilm, which some researchers believe can contribute to irritation. If the biofilm is alkalinized, healthy skin will rapidly regain its slightly acidic pH, but this may not be the case in skin disease. True soaps do an excellent job of removing surface sebum but also can remove the intercellular lipids.

The need to remove only surface sebum and leave the skin barrier undamaged led to the development of synthetic detergents known as *syndets*. Since syndets contain less than 10% soap, they can be used for daily bathing without causing eczematous disease in most individuals. Syndets also have a lower pH of 5.5 to 7 (similar to the pH of neutral skin), resulting in less alkalinization of the skin. However, this point is somewhat controversial. Some cleanser formulators believe that the product's pH should be as close to neutral as possible, since it does not alter the pH of the skin. This is in contrast to the view of some Japanese scientists who believe that skin care products, such as cleansers and moisturizers, should be formulated at a slightly acidic pH, because bacteria are more effectively eliminated in an acidic environment. Others state that the product's pH does not matter, because healthy skin returns to its normal pH rapidly after cleansing. The controversy has yet to be resolved, since much of the existing data supporting these various hypotheses originates from companies with a vested interest in the type of cleansers they manufacture for sale.

Nevertheless, syndet cleansers (eg, Cetaphil®, Dove®, Oil of Olay®) form the bulk of the bar soap products found in a dermatologist's sample closet. These products effectively normalize the biofilm. However, frequent use or use on diseased skin may still remove some of the intercellular lipids.

Probably the most interesting of the bar cleansers from a biofilm standpoint are the combars. These products contain both soap and syndet cleansers, sometimes with an added topical antibacterial such as triclosan. Most antibacterial bar soap formulations on the market are combars (eg, Dial®, Irish Spring®). While one might consider a topical antibacterial agent advantageous for normalizing the biofilm, there are some associated skin concerns. First, triclosan can cause skin irritation and possibly barrier dysfunction. Second, it is unclear whether the brief contact between triclosan and the skin surface is sufficient to provide enhanced biofilm normalization over the physical effect of rubbing the cleanser on the skin and rinsing along with the chemical interaction of the surfactant with the skin surface. Although it was previously thought that bacterial resistance to triclosan was not possible because it inhibits formation of the bacterial cell wall,

laboratory-grown organisms have been developed that are resistant to triclosan. At present, there are no known community-based triclosan-resistant bacteria. However, one wonders whether several decades from now organisms similar to methicillin-resistant *Staphylococcus aureus* will find their way into the public domain.

Cleanser Rinsability

Part of the function of a cleanser is to normalize the biofilm, but the cleanser must also rinse completely from the skin surface. While this is true for soaps and other alkaline pH cleansers, there is a new generation of skin cleansers designed to rinse away the biofilm from the skin surface and leave behind an oily moisturizing residue. These new cleansers are petrolatum-rich body washes such as Olay® Ribbons and ceramide-based lipid free cleansers such as CeraVe™ Cleanser. The petrolatum-rich body washes contain a syndet cleanser that solubilizes the skin's biofilm and rinses it away with water while leaving behind a thin film of petrolatum and oils to prevent damage to the skin barrier. The ceramide-based lipid free cleansers utilize a milky smooth film to solubilize the biofilm, which can either be wiped away with a cloth or rinsed with water. Lipid-free cleansers have formed the basis for facial cleansing in rosacea when individuals are intolerant to traditional bar and liquid cleansing products.

Novel Lipid-Free Cleansers

Lipid-free cleansers (eg, CeraVe Cleanser, Cetaphil Cleanser) are liquid products that clean without the aid of fats, which distinguishes them from the soap cleansers previously discussed. They are applied to dry or moistened skin, rubbed to produce lather, and rinsed or wiped away. These products may contain water, glycerin, cetyl alcohol, stearyl alcohol, or sodium lauryl sulfate. They leave behind a thin moisturizing film and can be used effectively in persons with excessively dry, sensitive, or dermatitic skin. They also do not produce burning or stinging, making them appropriate for use in the rosacea patient.

The newest development in lipid-free cleansers is the incorporation of ceramides into the formulation in a time-released structure known as a *multilamellar vesicle*. Multilamellar vesicles are in the form of an emulsion, hence the abbreviation MVE. Originally, ceramides were used in very expensive high-end moisturizers, since they were costly to produce. Now, ceramide 3, an important component of the intercellular lipids, is widely available and has been introduced into lipid-free cleansers in the mass market. The multilamellar vesicle emulsion cleanser is similar to the body wash formulation in that the biofilm is normalized and rinsed away, leaving a thin layer of multilamellar vesicles on the skin surface. In time the multilamellar vesicles, composed of concentric spheres of moisturizing ingredients, unfold onto the skin surface and release ceramides. This process combines normalization of the biofilm with barrier restoration, allowing cleansing to occur without damaging the stratum corneum.

The recognition that the skin can be cleansed without removing the intercellular lipids is an important dermatologic advance. Newer cleansing technology is not as focused on removing all substances from the skin surface as selectively normalizing the biofilm while allowing the skin to remain hygienic. This technology enables patients with sensitive skin, such as those with rosacea, to prevent disease recurrence via proper cleansing while avoiding diseases caused by improper cleansing.

Summary

The biofilm is an important dynamic in many skin diseases, especially rosacea. Mild cleansing combined with good hygiene can be a difficult balance to achieve. Fortunately, new skin cleansers remove dirt and oils from the skin while maintaining the intercellular lipids. A better understanding of the biofilm accompanied by new cleansing technology will result in healthier skin. ■