

# **New Advances in Chemical Peels: Maximum Potency with Minimum Discomfort**

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## **FOR FASTER ANTI-AGING RESULTS – CHEMICAL PEELS MAY BE FOR YOU**

As baby-boomers look in the mirror each day, they see the inevitable changes in their appearance caused by age, sun exposure and the environment around them. At some point, many women (and men!) decide that they want to “turn back the appearance clock” much faster than can be promised by the typical daily use “anti-aging” cosmetics or pharmaceuticals that only work gradually. After visiting a dermatologist, plastic surgeon or aesthetician, they are introduced to chemical peels—a very misunderstood collection of procedures that can be painful, but can promise more rapid and potent anti-aging benefits.

## **SKIN ANATOMY IN TWO EASY LESSONS**

Chemical peels can be divided into two general categories, depending on the depth of their effect. In a simple sense, the skin may be divided into two layers. The outermost layer of the skin is the epidermis and consists of the stratum corneum, the scaly, dry layer that forms the skin’s surface. The epidermal layers below the stratum corneum contain skin cells called keratinocytes that are destined to migrate from below to become new stratum corneum over a period of about three weeks. The epidermis also contains specialized pigment cells called melanocytes that inject melanin, an ultraviolet-absorbing pigment that is responsible for the many colors of human skin, from white (little melanin) to black (lots of melanin). A third component of the epidermis is a specialized set of sensory nerves that transmit the sensations of stinging, burning and itching when the skin is exposed to many irritating chemicals found in cosmetics, in the home and workplace, and in the environment.

Two important functions of the stratum corneum are to seal in the skin’s liquid components (e.g. water and the many nutrients dissolved in the water) and to protect against ultraviolet light that can kill skin cells and cause cancer. When one rubs the skin with a finger, loofa sponge, or cleanses, several layers of the stratum corneum are removed in a process called exfoliation.

The deeper second layer of the skin under the stratum corneum is called the dermis. It contains blood vessels, sensory nerves, sweat glands, hair follicles, and sebaceous glands, the “grease glands” that over produce the fatty oils during puberty that causes acne. It also contains various white blood cells of the immune system that protect the skin against microbial invasion and may trigger allergic

inflammation by releasing histamine and other chemicals that cause itching, redness and swelling.

### **MEDIUM to DEEP PEELS – “The Boiled Lobster Effect”**

In the late 1800s, physicians found that a variety of irritating chemicals applied to the skin could be used to reduce age-related skin changes, freckles, and acne. All of these chemicals caused a chemical burn initially, but as the skin healed many beneficial changes were observed. Interestingly, most of the chemicals first used in the early 1900s are still used today and include salicylic acid (closely related to aspirin which is acetyl-salicylic acid), resorcinol (an antiseptic and astringent), phenol (also called carbolic acid, a disinfectant), trichloroacetic acid (chemically related to vinegar) and lactic acid (an alpha-hydroxy acid or AHA, found naturally in the body and in fermented milk) and glycolic acid (derived from sugar cane).

Peels can be classified according to the depth of their penetration and their blistering and inflammatory effects. Peels that penetrate deep into the skin's dermis produce the maximum anti-aging benefits, but cause such extensive skin damage that the skin remains red and inflamed for days (the “boiled lobster look”), requiring bandages and potentially significant downtime from work or social activities. Such medium to deep-depth peels (e.g. trichloroacetic acid (TCA), Jessner's solution (a combination of salicylic acid, resorcinol, lactic acid and ethanol) and phenol) also carry a much higher risk of long-term changes in skin pigmentation that can cause either dark or light skin patches depending on the ethnic background of the patient. While these peels can work very well to reverse many of the visible signs of aged skin, the side effects can be substantial and many people are not willing to or able to deal with them.

### **SUPERFICIAL PEELS – “The Glycolic Acid Lunch Time Peel”**

Since most women (and men!) would like to have a skin rejuvenation treatment without the whole world knowing about it, the milder, or superficial peels have become very popular. Also called “lunch time peels” since one can have the procedure during the lunch hour and return to work immediately, they usually use glycolic acid at concentrations ranging from 20% to 70%. Since these peels have much less potential to cause serious side effects than medium to deep peels, they have become popular with aestheticians who typically use 20% to 30% glycolic acid concentrations that are formulated to be less acidic, and hence less irritating than their medically-dispensed versions.

As is usually the case, the most powerful lunchtime peels are reserved for physician use only. What makes a peel powerful? How can a consumer know if they are getting the most value for their money? The answers to these questions require a short explanation of how these peels work to produce younger-looking skin, and why irritation occurs at all.

### **WHAT MAKES A GLYCOLIC ACID PEEL POTENT?**

Extensive medical research has uncovered two key elements that control the ultimate anti-aging potency of AHA products in general, and glycolic acid peels in particular. The first key element is the concentration of the AHA in the product. For peels, the concentrations range from 20% to the most potent peel, 70% glycolic acid. As is frequently the case in agents that affect the body, more glycolic acid produces a greater overall benefit.

But a second key element is also needed to allow the glycolic acid to have its maximum potency. That element is the degree of acidity in the solution, which is measured by its pH.

At the risk of evoking painful memories of high school chemistry class, I will explain pH as simply as possible. Acidity is expressed on a 14 point scale using units called pH, each unit representing a tenfold difference in acid concentration. The pH scale ranges from 0 (highest acidity – e.g. battery acid) to 14 (lowest acidity or the most alkaline or basic, e.g. lye). When the pH is less than 7, the solution is termed acidic. The skin, for example, typically has a pH of 5.3 to 6.1 and is therefore slightly acidic. At a pH greater than 7, the solution is basic or alkaline, such as blood with a pH of 7.4 or a solution of sodium hydroxide, (NaOH), frequently found in drain cleaners which may have a pH of 13-14. Since each unit of pH is tenfold different from the next unit, a small change in pH means a large change in acidity. For example, a solution with pH 4 has 1000 times more acid than one with pH 7.

What do we mean by acid? In the simplest terms, acidity or pH measures the concentration of the positively charged hydrogen ion ( $H^+$ ) in water. Also known as a proton, this tiny atomic particle carries with it remarkable properties that act to rejuvenate the skin. In its simplest sense, an acid is any molecule that carries a proton that can be released into its environment. When the proton is released into the skin, for example, it stimulates the skin to renew new skin cells faster, therefore younger-looking skin is produced faster. Think of protons, in a sense, as fertilizer for your skin! When an acid has its proton “on board” and ready to be released, the acid is called “free acid”, since it is “free” to release its acidic proton.

All of this chemistry is important since in order for AHA cosmetics to have the most anti-aging effects, the AHA needs to be in its free acid form, in other words, the solution must be relatively acidic. And since a small change in pH means a big change in acid content (anti-aging activity), it is important that the pH of the AHA cosmetic is low, or you won't get your money's worth.

It seems simple enough that a glycolic acid peel should be formulated to be very acidic to maximize its anti-aging activity, and additionally, its anti-acne activity. So why isn't every glycolic acid peel very acidic? The answer, unfortunately, is that the more acidic the peel solution, the more irritating to the skin it is (nothing ever comes free, it seems!).

## **HIGH POTENCY GLYCOLIC ACID PEELS ARE VERY IRRITATING**

As any patient who has experienced a high potency glycolic acid peel knows, the stinging, burning itching, redness and even swelling can be substantial. For patients with sensitive skin, the problem can be far greater. High potency peels can also produce inflammatory damage that can result in increased or decreased pigmentation depending on the patient's ethnic background. These adverse reactions, termed post-inflammatory hyperpigmentation (increased) and hypopigmentation (decreased), respectively, can produce long-term changes in the skin that can be difficult to reverse.

## **HOW CAN IRRITATION BE REDUCED?**

For this reason, physicians, aestheticians and peel manufacturing companies have used many techniques to reduce sensory irritation and inflammatory damage from glycolic acid peels. Unfortunately for consumers, all but one of these techniques can also greatly reduce the "anti-aging" and anti-acne efficacy of peels.

The most common approaches include: (1) partially neutralizing the peel solution by reducing its acidity; (2) starting with a low glycolic acid concentration and gradually increase it over many visits; and (3) gradually increasing the peel application time over many visits, and (4) using an anti-irritant that protects against irritation and skin damage.

### **(1) PARTIALLY NEUTRALIZED PEELS**

Neutralization simply means to adjust the pH to be less acidic, and therefore less irritating. For example, the highest concentration glycolic acid peel is 70% and it naturally has a pH of 0.6, highly acidic. To fully neutralize it, its pH would be adjusted to 7.0 at which point it would be neither acidic nor basic. A partially neutralized peel has its pH raised in between its natural pH and 7, for example, some companies adjust the pH to between 3 or 4 by adding sodium hydroxide or a similar basic chemical.

So what's the problem - a partially neutralized peel is less acidic, and therefore less irritating? Unfortunately, since a pH 3.6 peel, for example has much less "skin fertilizer" (acidic protons) than an unneutralized 70% glycolic peel (1000 times less), the peel has much less ability to stimulate the skin to look younger as published studies demonstrate.

[A quick aside - many people (and some companies!) use the incorrect term, "buffered" peel, to represent a partially neutralized peel solution. A buffer is a chemical that tends to hold the pH of a solution constant. The act of increasing the pH of an acidic solution by adding a simple basic chemical only raises the pH, it does not buffer it. Therefore, the term "partially neutralized" solution should be used instead of a buffered peel.]

## **(2) LOW CONCENTRATION PEELS**

In another technique to reduce irritation, the patient is exposed to a low concentration peel solution (e.g. 20% glycolic acid) during the first visit, followed by increased peel concentrations in subsequent visits (e.g. 35%) and finally 50% or even 70% glycolic acid concentrations. Since published clinical studies clearly demonstrate that higher glycolic acid concentrations produce greater “anti-aging” efficacy, patients are being shortchanged compared to the efficacy they could get if they could tolerate the highest concentration peel available. And even if they do finally reach the highest potency peel, they have wasted much time and money on less potent peels during the process.

## **(3) SHORT PEEL APPLICATION TIMES**

A third technique to reduce irritation gradually increases the peel application time at any particular glycolic acid concentration. For example, during the first visit, a patient may have a 20% peel applied for 2 minutes, followed 2-3 weeks later by the same peel concentration for 4-6 minutes. By gradually increasing the skin exposure time, coupled with gradually increasing the peel concentration over many visits, patients may be able to tolerate the irritation and eventually experience maximum peel benefits of an optimum peel concentration and application time. Unfortunately, the cost of the visits that are used to condition the patients’ skin would not be necessary if irritation could be controlled.

## **(4) AN UNCOMMON SOLUTION: PROTECT THE SKIN FROM ITSELF!**

Wouldn’t it be nice if a patient could get the maximum concentration glycolic acid peel (70%), with the most effective pH (0.6) during the first day of their visit and have the peel left on their skin for a length of time to maximize the peel’s anti-aging and anti-acne potency (e.g. 4-6 minutes or more), AND, have minimal irritation? This “holy grail” of AHA products in general, and glycolic acid peels in particular has been the focus of over 10 years of medical research, and the goal has finally been accomplished!

### **STOPPING THE SKIN FROM DAMAGING ITSELF**

As I described in my previous article, *Skin Irritation* in the May 2001 issue of *Les Nouvelles Esthétiques*, the skin contains specialized nerves, type C nociceptors, (from the Latin nocere, to injure) that transmit stinging, burning and itching sensations to the brain, and also trigger redness, swelling and inflammation. These nerves are distinct from the A-delta nerves that transmit sharp, pricking pain sensations and the many other nerves of the skin that produce normal tactile sensations.

While type C nociceptors help to alert a person to potentially injurious chemical exposure, they can also actually damage the skin when they overreact to chemicals

that do not directly harm the skin. Such is the case with AHAs in general, and with glycolic acid peels in particular. It stands to reason that if a compound could be identified that could reduce the sensitivity of type C nociceptors, otherwise safe chemicals like glycolic acid could be used at the most effective levels while simultaneously protecting the skin from damaging itself.

After many years of research, such a compound was discovered, and it turned out that it naturally occurs in the body as well! This compound is the trace metal element, strontium, element 38 in the periodic table. Strontium, which closely resembles calcium, is unique in its ability to “turn down the volume control” of the type C nociceptors, thus reducing their potential to cause irritation and inflammatory skin damage.

### **MORE POTENT PEELS CAN BE SAFER THAN LESS POTENT PEELS**

An example of strontium’s skin protective effect is illustrated in a comparison of a 30% glycolic acid peel solution, partially neutralized to pH 3.0, the most potent peel recommended for non-physician use, with a 50% glycolic acid peel solution containing strontium without any neutralization (pH 1.2). In this study, 20 subjects sensitive to AHAs had one half of their faces painted with the 30% peel, and the other side painted with the 50% peel. Neither the subjects nor the investigator knew which treatment was being applied (a “double-blind” study). The level of stinging, burning and itching was quantified every minute for 10 minutes according to the following scale:

### **Sensory Irritation Scores (Stinging, Burning & Itching)**

#### **Commercially Acceptable**

**0 = none**

**1 = slight**----- transient irritation, noticeable but “doesn’t bother” them

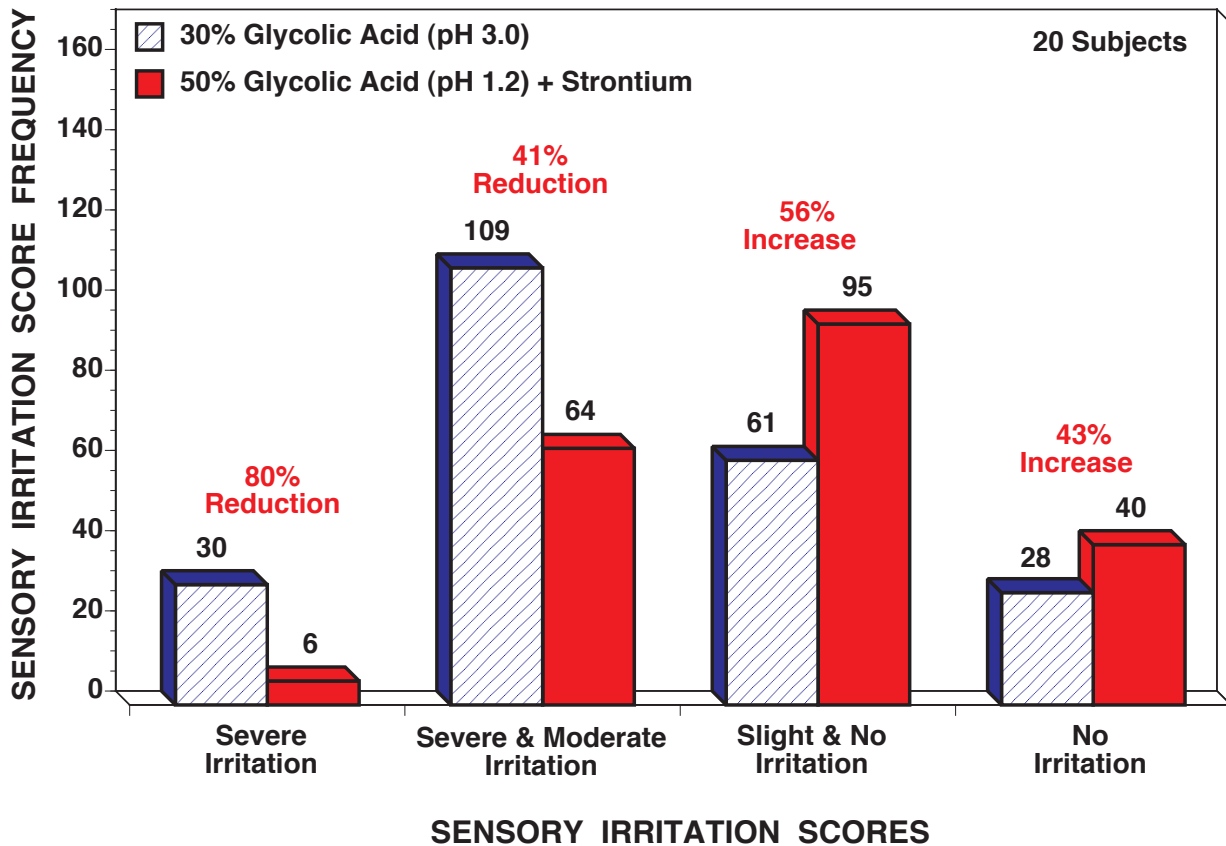
#### **Commercially Unacceptable**

**2 = mild** ----- continuous irritation, “bothers them”

**3 = moderate**----- “bothers them” & interferes with concentration

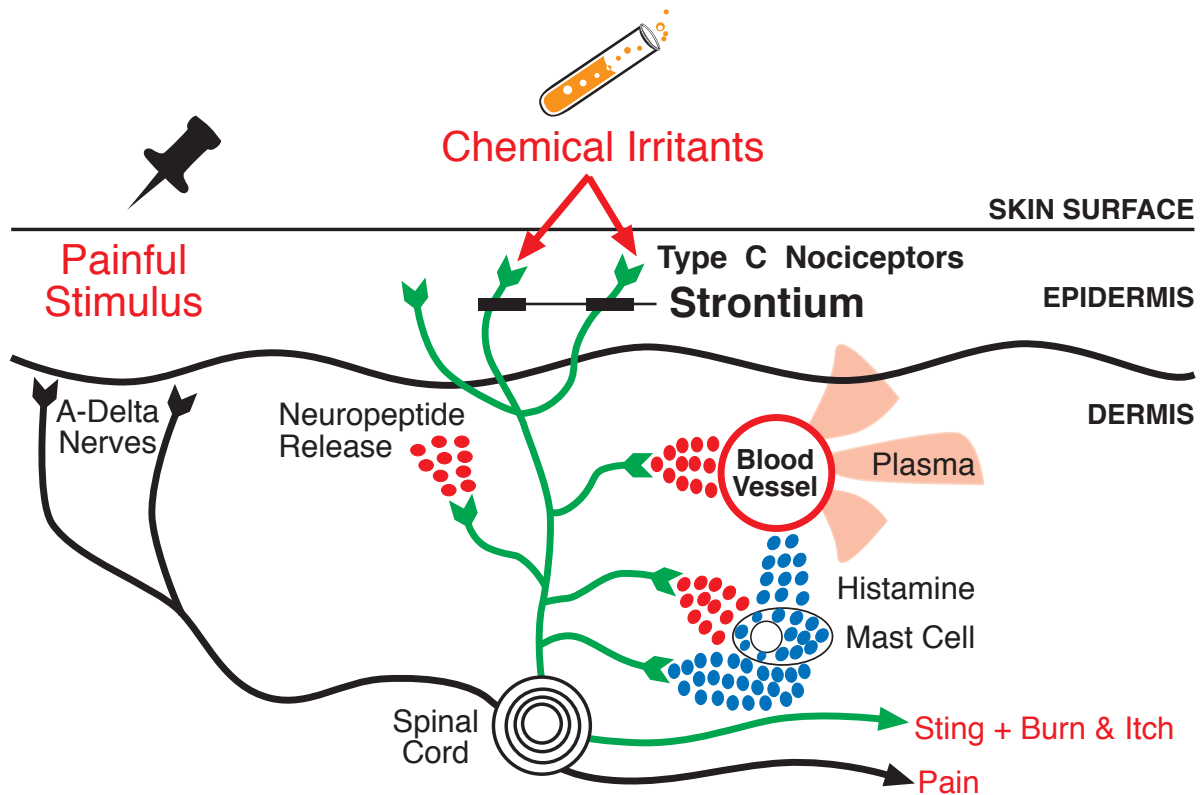
**4 = severe**----- intolerable irritation, redness and swelling possible

**GRAPH 1: Frequency of Sensory Irritation Scores**



**Graph 1** presents the frequency of the stinging, burning and itching scores reported by 20 subjects every minute for 10 minutes. The frequency of severe irritation was 80% less for the 50% peel than for the less potent, 30% peel. Severe and Moderate irritation was reduced by 41% for the 50% peel. Correspondingly, reports of slight (non-bothersome) irritation and no irritation was increased by 56% with the 50% peel while reports of no irritation at all were increased by 43% for the 50% peel ( $p < 0.05$ ). This study suggests that aestheticians could have a much more potent peel for their patients while providing a much greater degree of comfort and safety than the widely accepted (and safe) 30% peel.

## Strontium Mechanism of Action



**FIGURE 1** illustrates how strontium works. When the skin is pricked by a thumbtack, the A-delta nerves transmit the sensation of sharp, pricking pain to the spinal cord which relays it to the brain where the pain is consciously recognized. In sharp contrast (pun slightly intended), when a potential chemical irritant like glycolic acid contacts the skin, the type C nociceptors are selectively activated and transmit a sting/burn and/or itch signal to the brain. Topically applied strontium reduces the sensitivity of the nociceptors, which not only reduces sensory irritation, but also reduces the release of inflammatory neuropeptides from nociceptors that produce redness and inflammation. Since strontium does not affect A-delta or other nerves, pain and other normal tactile sensations are not affected.

Since inflammation and skin damage is not required for the anti-aging benefits of a glycolic acid peel, patients experience all of the benefits with minimal to no irritation. In a clinical study of 100 patients presented at the 1999 meeting of the American Academy of Dermatology by Mark Rubin, M.D., a nationally-recognized expert on chemical peels and author of *Manual Of Chemical Peels Superficial & Medium Depth*, Dr. Rubin reported that 85% of the patients experienced, at

maximum, a “non-bothersome” level of irritation while the other 15% of patients reported a maximum of mild irritation. Dr. Rubin concluded:

*“The addition of strontium nitrate to 70% free glycolic acid has a profound effect on reducing the sensory irritation and the level of erythema induced by the peel. ... According to our overall clinical evaluation, this new, low irritation 70% Glycolic Acid Peel containing strontium nitrate is as effective as any other 70% Glycolic Acid Peel with substantially less sensory irritation and erythema. This peel allows longer contact of the acid with the skin and eliminates the need to start with low concentration glycolic acid peels and gradually build up to 70%. Since this peel can protect the skin from the irritant effects of glycolic acid, the physician has more time to watch the skin and neutralize the peel. This suggests a greater margin of safety and lower change of accidental over peeling and vesiculation.”*

### **STRONTIUM PROTECTS THE SKIN FROM DAMAGE**

In addition to its ability to protect the skin from sensory irritation and redness, clinical studies have also demonstrated that strontium also prevents damage to the skin at the cellular level. In studies conducted by Hubert Greenway, M.D., et.al., at the Scripps Clinic and Research Foundation, patients were treated with twice daily facial applications of a high potency AHA lotion (15% lactic acid, pH 3.2) with strontium and a 70% glycolic acid peel (pH 0.6) peel with strontium every two weeks for two months. Biopsies of the AHA-treated skin were compared to non-AHA-treated skin in the same subjects. Microscopic analysis demonstrated that the AHA-treated skin experienced all of the expected “anti-aging” benefits (e.g. increased skin thickness, greatly increased synthesis of new collagen, elastin and the water-holding glycosaminoglycans), but did not show any signs of inflammation or other cellular damage. In fact, the AHA/strontium-treated skin had slightly less signs of inflammation than skin in the same subjects that had no AHA treatment at all.

Chemical peels have come a long way since they were first used by physicians and aestheticians to beautify the skin. As baby-boomers get older day by day, they are demanding maximum anti-aging performance with maximum comfort and minimum downtime. Chemical peels, especially glycolic acid peels, can provide maximum anti-aging benefits only when they are used at the highest concentrations and highest levels of acidity, a potentially irritating combination. New discoveries in the fields of dermatology and neuroscience offer an exciting potential to have it all – high anti-aging performance *and* extraordinary comfort.

**About the Author**

*Gary S. Hahn, M.D., is a graduate of Stanford University (BS, Biology) and the University of California, San Diego School of Medicine, is a licensed physician in California and serves as an Assistant Clinical Professor, Immunology and Allergy Division, Department of Pediatrics at UCSD. Dr. Hahn previously founded Immunetech Pharmaceuticals (now Dura Pharmaceuticals) where he served as Senior Vice President for Research and Scientific Director and Cosmederm Technologies. He is a member of the American Academy of Dermatology, Society of Investigative Dermatology and is an author of numerous publications, medical book chapters and pharmaceutical patents. He discovered and patented a technology, called COSMEDERM-7™, derived from the natural element strontium that has the unique ability to selectively reduce the sensitivity of type C nociceptors to chemical irritants and histamine without affecting pain or other tactile sensations. For this reason, products formulated with COSMEDERM-7™ can contain the highest “anti-aging” potency of active ingredients, including AHAs, while protecting the skin against irritation. For more information about products containing COSMEDERM-7™, please e-mail [Cosmederm7@cosmederm.com](mailto:Cosmederm7@cosmederm.com), or call toll free 1(866) 550-7070.*