Review article

Chemical peels: review and practical applications

Peelings químicos: revisão e aplicação prática

Authors:
Vania Marta Figueiredo Yokomizo[1]
Tania Maria Henneberg Benemond[1]
Chinobu Chisaki[2]
Paula Henneberg Benemond[3]

[1] Dermatologist Physician; Collaborator Physicianat the Department of Dermatology, Hospital do Servidor Público Municipal de São Paulo (SP), Brazil
[2] Dermatologist Physician, Assistant Physician, Department of Dermatology, Hospital do Servidor Público Municipal de São Paulo (SP)
[3] Fifth-Year Medical Student, Faculdade de Ciências Médicas de Santos, Fundação Lusíada (SP), Brazil

ABSTRACT

Cosmetic-driven research currently yields an avalanche of products and treatments for all dermatological sub-segments. Many treatments aimed at rejuvenating skin have been developed. Although chemical peels have now been used for more than a century–and despite the availability of new technologies–the treatment is still widely known and employed due to its practicality, low cost, and excellent results. The present study offers a review of all types of peelings recognized by the scientific literature – from the most superficial to the deepest – compiling the practical experience of the authors and detailed descriptions of the application technique, results, and complications.

Keywords: *chemexfoliation;phenol; skin.*

RESUMO

A pesquisa atual em função da cosmética desenvolve uma avalancha de produtos e tratamentos para todas as áreas dermatológicas a cada dia. Muitos tratamentos visando ao rejuvenescimento cutâneo têm sido desenvolvidos. Embora os *peelings* químicos sejam usados há mais de um século e apesar das novas tecnologias existentes, continuam amplamente usados e divulgados por sua praticidade, baixo custo e ótimos resultados. Os autores apresentam uma revisão de todos os tipos de *peelings* reconhecidos pela literatura científica desde o mais superficial até o mais profundo, acrescentando experiência prática com detalhada descrição da técnica de aplicação, resultados e complicações.

Palavras-chave: abrasão química; fenol; pele.

Correspondence:
Dr. Vania Marta F. Yokomizo
Av. Brigadeiro Faria Lima, 1597—conj. 403
Cep: 01452-917—São Paulo (SP), Brazil
E-mail: vaniamfy@yahoo.com.br

Received on: 27 February 2013
Approved on: 15 March 2013

The present study was carried out at the Dermatology Service, Hospital do Servidor Público Municipal de São Paulo—São Paulo (SP), Brazil.

Financial support: None
Conflict of interest: None

INTRODUCTION

An ever-growing number of peelings have continued toarise,improving on or being associated with existing ones, or innovating with new formulas.The controlled therapeutic desquamation caused by these procedures is a powerful weapon in the treatment of various diseases and aesthetic disorders.Their main indications are the treatment of spots, and scars and fine wrinkles, and can be performed on the face and body areas.

The term *peeling* originates from the English *to peel* = to come off in sheets or scales, to lose an outer layer,or to strip off. It refers to the application of a chemical agent to the skin that may cause the controlled destruction of part or all of the epidermis, leading to the removal of the lesions with exfoliation, and followed by the regeneration of new tissues.[1,2]

HISTORY

Chemical peelings were first described in Egyptian medicine in 1550 BC, in the Ebers papyrus. Reports are also found in ancient Greek and Roman literature .In previous centuries, some formulas were passed on by peoples of Gypsy origin. Dermatologists began to show an interest in peelings in the nineteenth century. In 1874, in Vienna, the dermatologist Ferdinand Von Hebra used the technique to treat melasma, Addison's disease, and ephelides. In 1882, in Hamburg, Paul G. Unna described the actions of salicylic acid, resorcinol, trichloroacetic acid (TCA) and phenol on the skin. His early work was followed by a prolific academic production.[3]

The use of phenol was developed after the First World War, in France. In England, Mac Kee had already used phenol to treat scars, but did not publish his results until 1952. Meanwhile, in the United States during the 1940s, Eller and Wolff provided the first systematic description of the use of phenol, salicylic acid, resorcinol, and dry ice for the treatment of scars. Themodern era of peelings began in the 1960's, with the development of modified solutions of phenol (addition of croton oil, septisol and water) by Baker and Gordon, and with the histological evaluation of results, comparing effects between phenol and TCA. The scientific basis for TCA-based treatments was expanded in the 1970's and early 1980's through the comparison of histological effects caused by three different TCA concentrations. Concomitantly, alpha-hydroxy acids (AHA) were developed by Van Scott and Yu for more superficial peelings, which were indicated for the treatment of hyperkeratosis. The glycolic acid-based peeling was developed later on.The combination of two substances aimed at achieving medium depth effects, described by Brody and Hailey, and subsequently by Monheit, lent further progress in the use of peelings. The most recent development is the use of lipohydroxy acid (LHA).[4,5]

CLASSIFICATION

Peelings can be classified according to depth into:

- Very superficial:removing the stratum corneum (depth = 0.06 mm);

- Superficial: causingepidermal exfoliation of the granular layer up until the basal layer (depth = 0.45 mm);

- Medium: reaching the papillary dermis (depth = 0.6 mm)

- Deep: reaching the midreticular dermis (depth = 0.8 mm).

The deeper the peelings, the more apparent the results—however risks and discomfort in the period after the procedure will also increase.

The criteria used in the indication of each peeling type include age, skin phototype, body area to be treated, degree of photoaging, results sought, and the skill fulness of the applicator physician, in addition to factors intrinsic to each patient.[2]

The absorption of the medications varies according to:

- Characteristics of the skin: thickness of the epidermis, density of the follicles, degree of photo-aggression, gender (male skin is oilier, hampering penetration), skin phototype (the lower the phototype, the greater the penetration), integrity of the epidermal barrier, previous preparation, cleansing prior to the exfoliating agent application, previous procedures, and recent use of oral isotretinoin;

- Chemical agent: physico-chemical characteristics, volume, concentration, vehicle, duration of exposure;

- Application technique: use of swabs, brush, gloved fingers or gauze, occlusion or not of the treated area, pressure and friction during application, number of layers and frequency of the procedure.

The doctor must have adequate knowledge of the different agents for chemical exfoliations, of the skin regeneration process, of the technique, and of how to identify and treat complications.[1]

PRIOR PREPARATION

When indicating a peeling, the physician must consider the patient's psychological profile, professional activity, and time available for recovery. Detailed information must also be provided through educational material, indicating the necessary preparation beforehand, and clarification on the period of desquamation and expected benefits.

The anamnesis must include the patient's medical history, degree of exposure to the sun, occupation, herpes simplex history, treatment with isotretinoin in the previous six months, tendency for developing keloids and post-inflammatory hyperpigmentation, use of medications, immune impairment, and smoking habits, which despite not being relevant in superficial *peelings*, can cause alterations to the outcome of deep procedures. For phenol *peelings*, it is necessary to investigate systemic diseases in general and heart diseases in particular.

In the dermatological examination it is necessary to investigate the patient's phototype, degree of photoaging, and sebaceous activity (oily or dry). In addition, the presence of post-inflammatory hyperpigmentation, the presence or history of keloids, and preexisting infection or inflammation must be verified.

The preparation must be initiated at least two weeks prior to the procedure, since it reduces the healing time,allows a more uniform penetration of the agent and decreases the risk of post-inflammatory hyperpigmentation. Very superficial *peelings* do not need previous preparation, however deeper *peelings* require it in proportion to the desired depth. The preparation is carried out with substances that provide a conditioning effect on the skin. Formulas containing retinoic acid (from 0.025 to 0.1%) and/or glycolic acid (5 to 10%), associated or not with depigmenters such as hydroquinone (2.5 to 5%), kojic acid (1 to 2%) or phytic acid, are used in vehicles appropriate for each skin type.6Care with exposure to the sun is essential, even before the application of the peeling. Sunscreens with a high SPF and moisturizers are indicated throughout the process of the skin's recovery. Patients with a history of herpes simplex mustundergo prophylactic antiviral therapy (acyclovir 200mg—4/4 hours or valacyclovir 500mg—12/12 hours, for five days).

It is mandatory to obtain the informed consent of the patient and carry out a photographic documentation.

The following observations are important for the safe application of the *peelings*:[7]

- Avoid applying on irritated, erythematous, or inflamed skin
- Always have available the neutralizing substance of the-chemical agent being used
- Use the pain scale (ranging from 1 to 10)
- Be continuously aware of visual signals, such as erythema and whitening (frosting), which help to identify the degree of penetration of the substances and the depth reached (Figure 1)
- Very superficial *peelings*: erythema only
- Superficial *peelings*: arboriform frosting with erythema on the background
- Medium depth *peelings*: uniform and solid frosting

SUPERFICIAL AND VERY SUPERFICIAL *PEELINGS*

As superficial and very superficial *peelings* affect only the epidermis, the best results are obtained with serial applications, performed at short intervals. The subsequent desquamation is usually thin and pale in color, and doesnot have an impact on the patient's daily routine. These *peelings* improve the skin texture, are adjuvants in the treatment of acne, 8lighten spots, and attenuate fine wrinkles in addition to stimulating collagen renewal.

Agents for very superficial *peelings*:

- 30% glycolic acid, for one to two minutes
- Jessner'ssolution, one to three layers
- 30% salicylic acid
- 20-30% resorcinol, for five to ten minutes
- 10% trichloroacetic acid, one layer
- Lactic acid
- Phytic acid

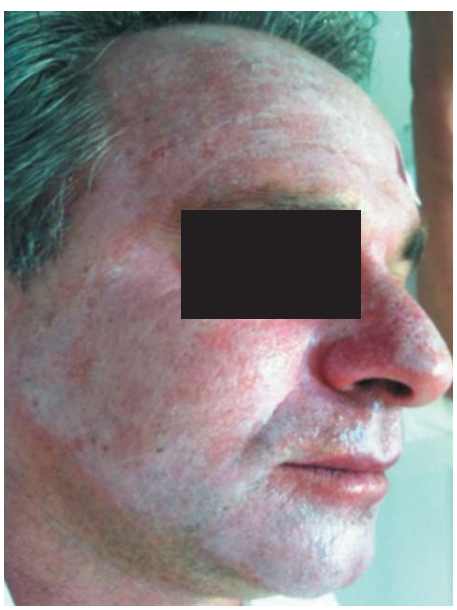

Figure 1: Immediatepost-*peeling*: frosting.

Agents for superficial *peelings*:

- 10% retinoic acid
- 50-70% glycolic acid, for two to 20 minutes
- 10-25% trichloroacetic acid
- 40-50% resorcinol, for ten to 20 minutes
- Jessner's solution, four to ten layers
- Mandelic acid
- Pyruvic acid
- Thioglycolic acid

MEDIUM DEPTH *PEELINGS*

Medium *peelings* cause thick and dark desquamation, demanding between 7 to 15 days for the return to normal life. They are indicated for keratoses (precancerous lesions) and more pronounced wrinkles.

Agents for medium *peelings*:

70% glycolic acid, for 3 to 30 minutes
Jessner's solution + 35% trichloroacetic acid
70% glycolic acid + 35% trichloroacetic acid
35-50% trichloroacetic acid

DEEP *PEELINGS*

Deep *peelings* are stronger and more aggressive than other procedures. They cause the formation of numerous thick crusts, and the post-peeling may require the use of dressings.The recovery time may last up to three months. This peeling depth leads to significant results, with a major renovation of the skin and a decrease of deep wrinkles, such as wrinkles located around the mouth and eyes.

Agents for deep *peelings*

- Phenol
- Baker's solution

COMBINED DEPTH *PEELINGS*

When aiming at obtaining more noticeable results in shorter times, the combined *peelings* technique—which corresponds to the association of two types of substances in the same session—can be used. It takes advantage of the best effects of each substance, resulting in a more efficient action without unnecessary deepening.For example, Jessner's solution can be combined to 35% TCA; or 10% TCAcan be combined with 5-10% retinoic acid; or even 70% glycolic acid can be combined with resorcinol, one over the other.

It is also possible to use different acid types and concentrations according to the alterations of each area of the face. Medium depth *peelings* can be used only in sites where photoaging is more pronounced, using weaker acids in areas where the damage is more limited. In this manner, the more intense side effects remain restricted to places where stronger acids were used, reducing the discomfort in post-peeling. The adjustment of the depth must follow the concept of aesthetic units.

For the rejuvenation of middle-aged patients with photodamaged skin,the following can be used (Figure 2):

- frontal, malar, and mentum regions: Jessner's solution + 35% TCA
- periorbital region: 88% phenol
- supralabial region: Baker's solution.

CHEMICAL *PEELINGS*: ONE-BY-ONE *(on an individual basis)*

Retinoic acid peeling

It is used in concentrations ranging from 5-12%. It can be dispensed with tinted gel, lotion, cream, or propylene glycol vehicles.

Its mechanism of action is characterized by:
- thinning and compression of the stratum corneum
- reversal of atypias in epidermal cells
- dispersion of melanin in the epidermis
- stimulation of dermal deposition of collagen
- increased deposition of glycosaminoglycans
- increaseddermal neovascularization[9-10]

It is indicated in cases of mild-to-moderate photoaging, melasma, acne, superficial scarring, and post-inflammatory hyperpigmentation[11-13] (Figure 3). It must not be recommended for pregnant women. Before application, the skin must be treated with alcohol to remove all oils. This can be carried out with a gloved hand, gauze, or brush, depending on the method used. After being applied, the peeling will create a sort of mask that must remain on the face for 4 to 24 hours. It is then removed with water and mild soap or cleansing lotion. Applications can be serialized, weekly or monthly. Complications with this procedure are rare, with acneiform eruption, telangiectasias, and superficial keratitis being cited in the literature.[14]

Glycolic acid peeling

Glycolic acid is an alpha-hydroxy acid (2-hydroxyethanoic) found in sugar cane or synthesized from formaldehyde. Given that it presentsa highly variable penetration, it is not suitable for medium or deep *peelings*, being more frequently used in superficial *peelings* in concentrations between 30-70%. The penetration may vary according to the formulation's pH. The lower the pH, the greater the probability of the glycolic acid to penetrate, with the possibility of penetrating considerably in more sensitive areas. A 70% glycolic acid (GA) solution with pH 2.75 has 48% free GA. If the pH is 0.6, all of the acid component will be free. The 50% GA solution at pH 1.2 has 48% free GA.

The solution's presentation can be in the form of a water solution or a mixture of water, alcohol, and propylene glycol, or still in gel form, which facilitates the application (Figure 4). The application is carried out after the cleansing of the skin with alcohol, using a brush or gauze, in a quick and uniform way. The skin must be continuously observed to prevent burns. The emergence of a whitish gray color corresponds to epidermolysis, with a frost-like appearance meaning a dermal lesion.

Glycolic acid causes epidermolysis over a period varying from three to seven minutes, depending on the skin's type. Because it is not absorbed, it is not toxic. There is a necessity for neutralization with water or 10% sodium bicarbonate. It is indicated for active acne, melasma, and mild dermatoheliosis.

Serial glycolic acid *peelings* with fortnightly intervals, allow excellent results.

Infections and scarring are rare when the procedure is well conducted.[14-15] Herpes labialis must be prevented with oral

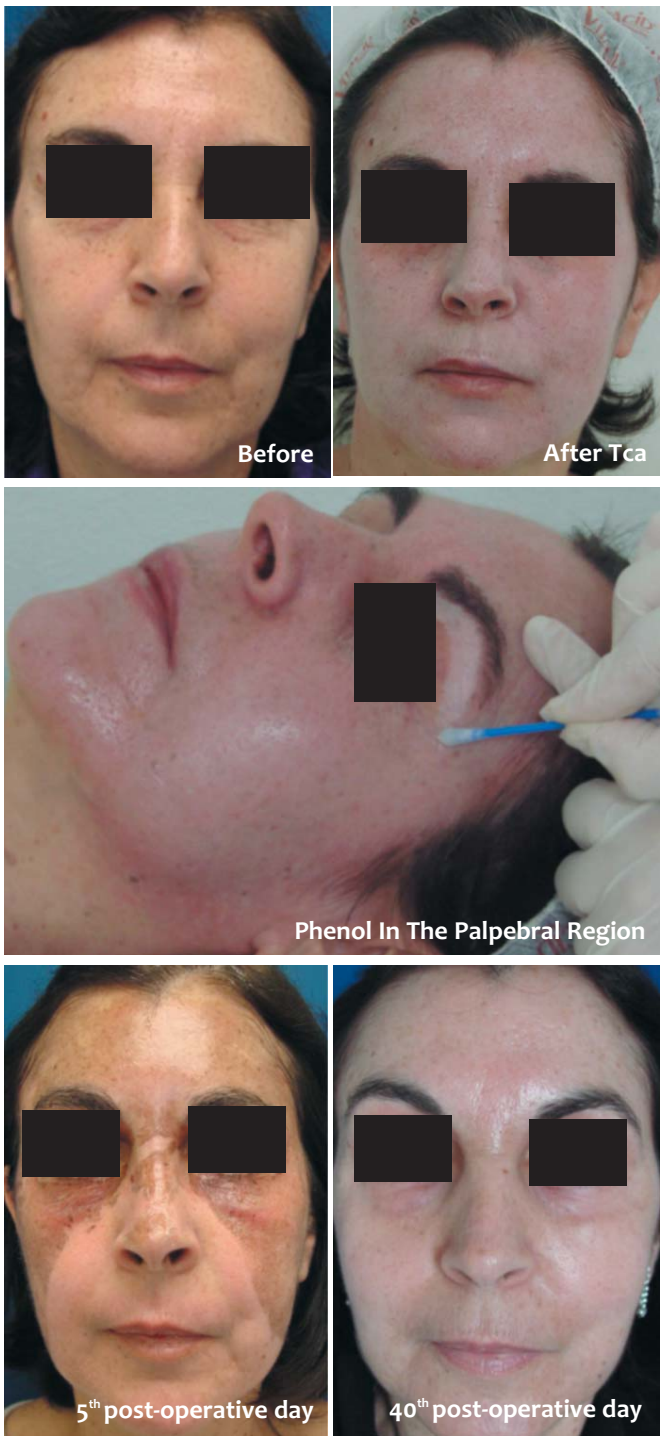

Figure 2: *Combined peeling: Jessner + TCA in the face + 88% phenol in the palpebral*

Figure 3: *5% Retinoic acid peeling*

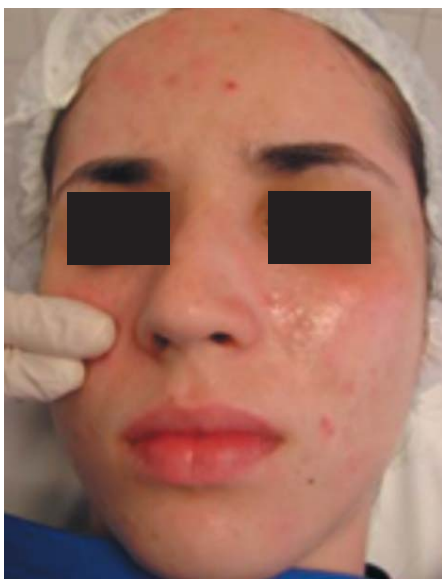

Figure 4: 70% glycolic acid *peeling* gel application with gloved fingers

anti-herpetics in the case of previous history.

Lactic acid peeling

Lactic acid also is an alpha-hydroxy acid, used at 85%, pH 3.5 in hydroalcoholic solution, with activities similar to those of glycolic acid. It can be used as a peeling agent in the treatment of melasma.It is a low cost and easy to use product.

The first pilot study was carried out by Sharquie et al., who showed that it was a safe and effective peeling agent for the treatment of melasma in dark skins.[16]

Phytic acid peeling

Phytic acid is an alpha-hydroxy acid that has efficiency at low pH and does not require neutralization.17It has progressive and sequential therapeutic action, in a non-aggressive manner. It does not cause a burning sensation. The solution is applied to the face and left until the following day. It can be repeated weekly or twice weekly should afaster effect be required, up to a total of five or six sessions. It is very safe and effective agent for the treatment of melasma in dark skins.[16]

Pyruvic acid *peeling*

This is performedin concentrations of 50%, 60%, and 80% of the acid,diluted in ethanol. Pyruvic acid is an alpha-keto acid. Its mechanism of action is the epidermolysis, which takes place in 30 to 60 seconds. It penetrates the skin in one to two minutes, and has no systemic toxicity.

It is indicated for the treatment of extrinsic aging, acne, and superficial scarring due to its keratolytic, antimicrobial, and anti-seborrheic properties as well as its ability to stimulate the formation of new collagen and elastic fibers.[18]

After previously removing skin oils with alcohol, it can be applied with a damp gauze using mild pressure. When erythema followed by frosting arise (between two and five minutes), it must be removed with water,for the patient's comfort.

The erythema resulting from the treatment can last from 15 days to two months.

Pyruvic acid can decompose over time, forming carbon dioxide gas and acetaldehyde; these vapors, if inhaled, may be caustic and irritating to the upper respiratory tract.Prevention is achieved with the use of a fan during application.

It is important to note that pyruvic acid peeling is a product whose penetration is unpredictable, and thus must be used with caution. Its very fast penetration can lead to the formation of scars.[16]

A recent study in patients with Fitzpatrick skin types II and III was conducted by Berardesca et al., who used a new, less inflammatory formulation (50% pyruvic acid) with significant benefits in its tolerability—mainly linked to burning sensation—during application and in the post-peeling.[19]

Salicylic acid *peeling*

Salicylic acid is a beta-hydroxyacid, formulated at 20 or 30% in alcohol solution or at 40 or 50% in ointment,for application in upper limbs. It has keratolytic action and can promote very superficial or superficial *peelings*.

It is indicated for mild to moderate photoaging, melasma, and superficial acne scars, and is anexcellent agent for treating any skin disorder in people with dark skin types.[20] It is contraindicated in patients allergic to salicylic acid.

Formulations

Solution: Salicylic acid (20 or 30%) / ethanol 96 °GL (30m) / acrylate copolymer (colophony) - qsp (the copolymer has adhesive action on the skin, providing the formation of a salicylic acid film as the ethanol evaporates).

Ointment: Salicylic Acid (40 or 50%) / Methyl salicylate sodium(16 drops) / Solid petrolatum (112g).

Application method: After degreasing the skin with alcohol, apply one or two layers of 20 or 30% salicylic acid with gauze or brush. As penetration is limited, the number of layers is not relevant. Wash with mild soap and water after five minutes. Do not apply over large areas and avoid applying in patients with renal insufficiency.

The percutaneous absorption of salicylic acid can lead to

salicylism, which can be characterized as:

- mild: rapid breathing, ringing in the ears, hearing loss, dizziness, nausea, vomiting and abdominal pain

- severe: alterations in the central nervous system with mental disturbances(similar to alcoholic intoxication)

Other possible complications are allergic reactions (rare) and post-inflammatory hyperpigmentation. More recently, a new derivative of salicylic acid was introduced with the addition of a lipid chain (lipohydroxy acid), which has higher lipophilicity in comparison to salicylic acid, promoting a more specific mechanism of action and greater keratolytic effect.It also modifies the stratum corneum making it thinner, more flexible and more resistant to wrinkling and cracking. Although it has shown good results in patients with acne,[21] its effectiveness in melasma is still being studied.

Salicylic and mandelic acids *peeling*

This is a combination of a 20% beta-hydroxy acid (salicylic acid) with a 10% alpha-hydroxy acid (mandelic acid). It is still not frequently used. In addition to the benefits of the combination—in which the salicylic acid penetrates rapidly and the mandelic acid penetrates the epidermis slowly and evenly, which is ideal for sensitive skins—it has the added benefit of preventing post-inflammatory pigmentation, making it especially useful for ethnic skins. It is indicated for the treatment of acne, post-acne scars, and dyschromias, including melasma. Studies by Garg et al. demonstrate that the combination of salicylic and mandelic acids is more effective in treating active acne and post-acne hyperpigmentation than the traditional glycolic acid *peeling*, with fewer side effects.[22]

Thioglycolic acid *peelings*

Also known as mercaptoacetic acid, it is a compound that includes sulfur with a molecular weight of 92.12 (between trichloroacetic and glycolic acids, with 76.05 and 163.4, respectively). It ishighly soluble in water, alcohol, and ether, being easily oxydated.[23]

Concentrations of 5-12% are typically used in the approach of hemosiderotic hyperchromies. Its affinity for iron is similar to that apoferritin—with the capacity to chelate hemosiderin's iron—for presenting the thiolic group.[23]

It is an organic acid. As an agent for chemical *peelings*, it can be used to treat constitutional periocular hyperchromia,[23] and in hemosiderin deposits (such as the ochre dermatitis of the legs) it proves to be an excellent therapeutic adjuvant in the approach to these dermatoses.

Serial and progressive thioglycolic acid *peelings* are seen as safe, efficient, and cost effective therapeutic tools to treat constitutional periocular hyperchromia[24] (Figure 5).

Application method: After removing body oils in the periocular region with 70% alcohol (with the aid of swabs), 10% thioglycolic acid gel is applied to the lower eyelid, observing the limits of the cosmetic unit. In the first session, the product is removed with gauze after two minutes of agent contact with the skin. The area must be subsequently washed with water in order to removethe substance completely. It can cause mild discomfort associated with mild erythema. In case of contact with the ocular conjunctive, the latter must be washed vigorously, given that the product has low ocular toxicity. Two or three days later, the skin is expected to be erythematous, sometimes with thin and brownish crusts, and mildpalpebral edema. This process can last up to seven days and is directly related to the skin's duration of exposure to the product. Up to five sessions applied with a fortnightly interval are indicated. Three minutes are addedto each session, with the duration of the agent contact with skin lasting 15 minutes in the last session.

Biweekly sessions of 15% thioglycolic acid in all pigmented areas can be carried out for the treatment of ochre dermatitis.

Tranexamic acid *peelings*

Tranexamic acid has been effectively used to reduce hyperpigmentation in patients with melasma through applicationsof 3-5% tranexamic acid cream, twice a day, at home. The

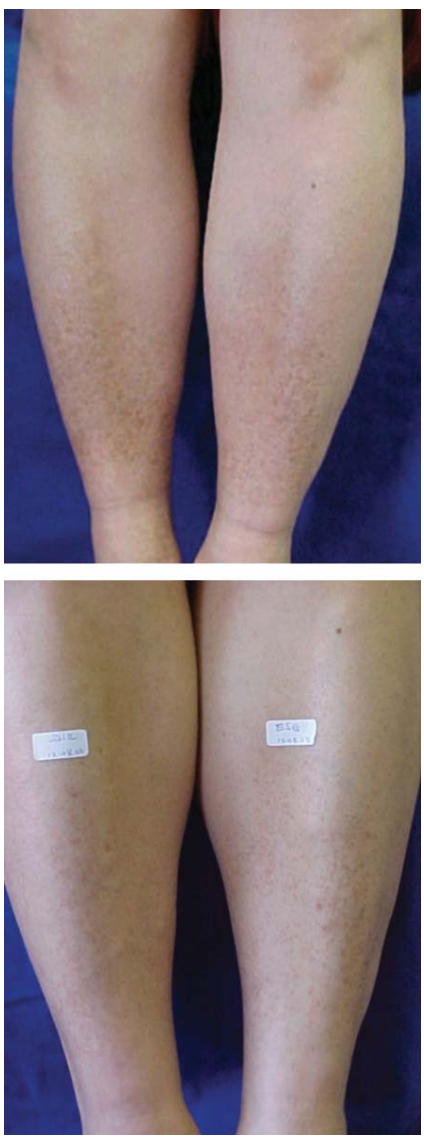

Figure 5: 15% thioglycolic acid *peeling*.Ten biweekly sessions in ochre dermatitis

product can also be used on spots, through weekly intradermal injections with 0.05 ml of tranexamic acid (4mg/ml) per each square centimeter of melasma, after topical anesthesia with 2% lidocaine hydrochloride.25 There is controversy about its results in topical applications.[25-27]

Resorcinol *peeling*

Resorcinol is a caustic agent from the phenols group, however with different properties. It can be used as an exfoliant in the form of solutions or ointments, in concentrations ranging from 10-70%, or associated with other substances.

Used in concentrations of 40-60%, an ointment's penetration increases according to the duration of exposure and the thickness of the layer. It can be applied with a wooden spatula or gloved fingers, and should be left in contact with the skin for up to 20 minutes. After drying, the mask is removed with a spatula, with any residue cleaned off with gauze soaked in water (Figure 6).

The advantages of ointments are stability and low cost. They can be used on darker skins, which are more prone to hyperpigmentation. A disadvantage is the possibility of allergic reaction and intoxication, the probability of which increases with multiple passes.

Indication: acne, dyschromias, fine wrinkles, and post-inflammatory hyperpigmentation.

Jessner's*peeling*

The solution developed by Max Jessner is composed of 14% salicylic acid, 14% lactic acid, and 14% resorcinol in 95% ethanol. Salicylic acid is photosensitive and lactic acid absorbs water present in the air, hence the solution is sensitive to light and air. It is suitable for comedonal acne, post-inflammatory hyperpigmentation, mild melasma, and photoaging. Its mechanism of action is based on the salicylic acid and resorcinol's keratolytic property and the lactic acid's epidermolysis action. The penetration depends on the number of layers, and medium depth *peelings* can be used. It can cause a burning sensation, which may (or may not) be helped with water. It can be applied in the face and body (neck, dorsum), nevertheless the procedure must be carried out in only one area per session in order to avoid risk of salicylism.

Application method: After cleansing the skin with alcohol, apply the solution uniformly with a brush, gauze, or cotton. Reapply a new layer after three or four minutes. Rinse with water, removing the crystals of salicylic acid.

Depth levels:

- Level I: one layer. Causes mild erythema and whitish flaking on the surface resembling a powder that can be easily removed

- Level II: two to three layers. A more marked erythema is absorbed, as well as frosting in dotted and thin areas. There is a mild to moderate burning sensation

- Level III: three to four layers. Causes significant erythema, with areas of frosting and moderate burning sensation

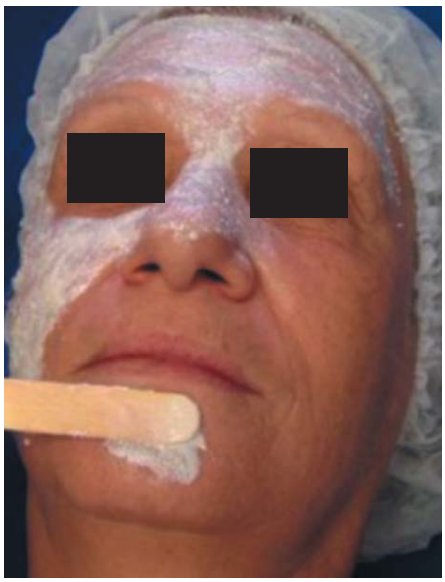

Figure 6: *60% resorcinol peeling*

Complications are related to the resorcinol's and salicylic acid's systemic toxicities, and are based on the absorbed amount of those substances, which in turn vary with the extension of the treated area and number of layers applied. Intoxication by resorcinol causes tremors, circulatory collapse, hematuria, methemoglobinemia, methemoglobinuria, and hypothyroidism. Dizziness or syncope may occur, caused by vasodilation resultingfrom the use of resorcinol. Prevention of these symptoms can be achieved by preferably carrying out the procedure with the patient lying down and being instructed to stand up slowly at the end of the procedure.

Resorcinol can cause contact dermatitis. In order to prevent this, a prior test with the agent must be carried out in the retroauricular region.

The product should be left on the application area for 15 minutes and re-evaluated after two days. Erythema, edema, and vesicles are indicative signs of allergic reaction.

Jessner's *peeling* can be associated to 35% TCA, retinoic acid, and 5-fluorouracil—the latter in the treatment of actinic keratoses. Gary Monheit was the first to popularize the use of the combination of the classic Jessner's solution with 35% TCA. The use of the Jessner's solution allows a uniform penetration with low and safe concentrations of TCA. Safoury28 compared the results obtained with the Jessner's solution combined with 15% TCAand isolated 15% TCA, with significantly better results having been observed on the side treated with the combination.

Trichloroacetic acid *peeling*

TCA allows the implementation of superficial, medium depth,and deep *peelings*.

10% TCA: superficial *peelings*

10-30% TCA: medium depth *peelings*

35-50% TCA: deep *peelings*

There is a great risk of scarring when applied in concentrations above 50%, which are not recommended.

In order to prepare a 30% solution, 30 grams of TCA crystals are dissolved in water up until obtaining a volume of 100ml.

The solutions can be applied with cotton swabs or gauze, and 10-20% ointments, with spatulas (Figure 7).

Application method: After removing all skin oils with alcohol, apply the product with slightly moistened gauze. Start from the frontal region, followed by the nose, malar and perioral regions, and eyelids. Evenly distribute the solution mainly in the borders in order to avoid demarcation lines. The goal is to achieve a uniform coating. Reinforce the application in areas where necessary.

It is important to watch for the presence of tears forming in the patient's eyes, in order to prevent the dilution of the acid and avoid it flowingto areas such as the neck, for example, which must not be affected. It can be helpful to use a fan on the face of the patient to make the application more bearable. Intense hydration and use of sunscreen are recommended throughout the desquamation stage.

The TCA precipitates the epidermis' proteins, causing necrosis due to coagulation. It is a very versatile *peeling*, with excellent rejuvenation results and improvement of scars, and as a treatment for actinic keratosis and melasma. It does not cause systemic toxicity.[4]

If methyl salicylate is added, activation of TCA is achieved. The first drug works as a carrier, increasing the degree of penetration and allowing a faster and more intense whitening effect.

Formulation: 35% TCA / 5 to 10% methyl salicylate / 1% Polysorbate / distilled water (qsp).

The addition of saponins also makes its application more uniform.

Formulation: 35% ATA / 5% saponins complex.

Another variation of the TCA *peeling* is the Obagi Blue Peel®, a compound of fixed concentration of TCA, added to a non-ionic blue base containing glycerin and saponins.[24] In a study of 18 Korean women, this *peeling* was compared to the application of 1,550nm erbium laser. The improvement in melasma caused by both treatments was significant, with no difference between the two therapies.[29]

Phenol *peeling*

Phenol, or carbolic acid (C6H5OH), is derived from coaltar.It has a molecular weight of 94.11 and is in the form of needle-shaped crystals, ranging in color from clear to pink, with a characteristic odor. It becomes liquid when heated, releasing a flammable vapor, and darkens when exposed to air and light. Its melting and boiling points are approximately 39°C and 182°C.6It has bacteriostatic effects at minimum concentrations of up to 1%. Above that concentration it has bactericidal action. It acts as a local anesthetic in the skin's nerve endings.It is oil and fat-soluble and can be quickly removed from the skin with glycerin, vegetable oils, or 50% ethyl alcohol, in case of accidental contact.

When used at a concentration of 88%, it penetrates the upper reticular dermis, coagulates the keratin, and prevents its permeation to deeper levels.

The Baker-Gordon formula (1962) is the more widely known formulation used in *peelings*, employing phenol in concentrations from 45-55%, promoting deep *peeling*:

Phenol: 88% phenol + 12% water (3ml) / common or distilled water (2ml) / Soap: liquid hexachlorophene (0.025%, 8

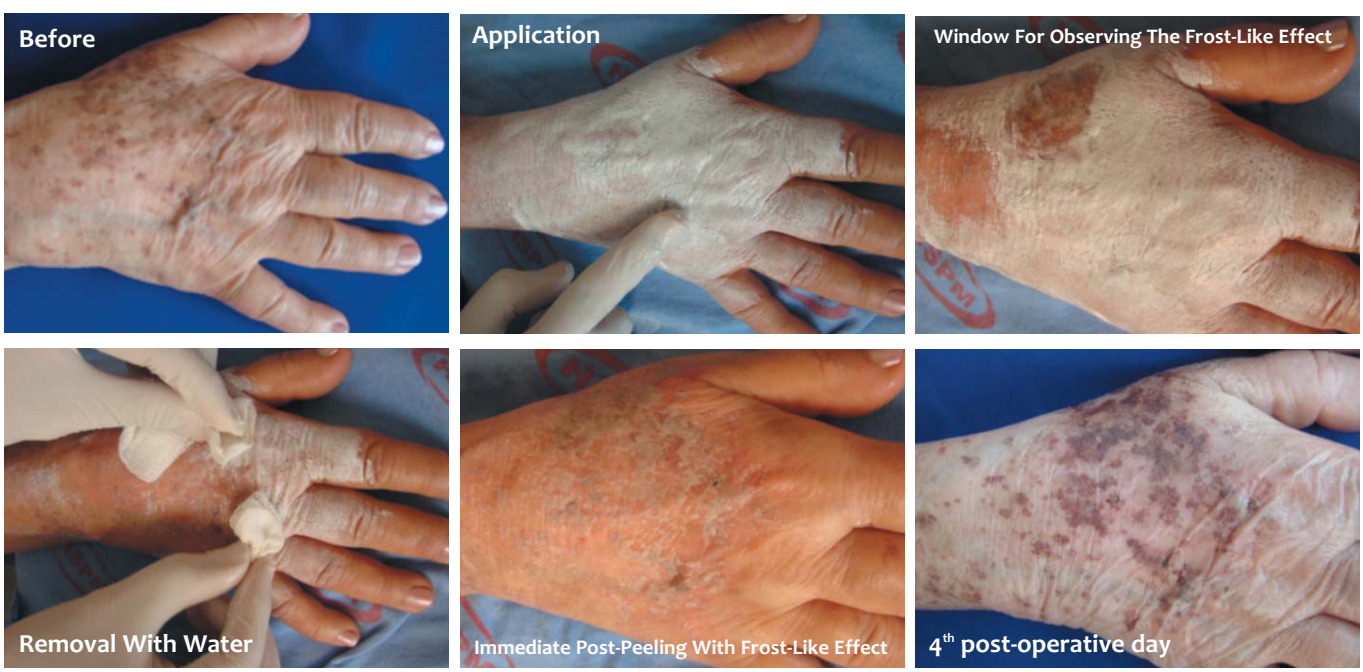

Figure 7: 20% TCA *peeling* ointment

drops) / Croton oil: (3 drops).

Croton oil is extracted from the seed of the Croton tiglium plant and is a component that increases the phenol's keratocoagulating capacity and skin penetration by increasing the site's vascularization. It is deemed a resin, and its bioactivity is due to the free hydroxyl groups (OH), being highly toxic to the skin, causing edema and erythema. It is insoluble in water and highly soluble in alcohol and benzene (phenol is a monohydroxybenzene).[6]

Because it is a surfactant (detergent), the liquid soap acts as a vehicle in the formulation and reduces the surface tension of the oil present in the skin, removing it by emulsification, thus providing uniform exfoliation. In this manner it also acts to promote penetration.[6] The Baker-Gordon formula is a suspension comprising thin particles of solid component dispersed in a liquid medium and should be agitated before use.[6]

This formulation produces *peeling*, and is indicated for the treatment of deep wrinkles and actinic keratoses caused by severe photoaging, in any region of the face.

Its proper use requires prior anamnesis, physical examination, and laboratory tests, given that phenol is absorbed systemically from the skin and may cause cardiotoxicity, nephrotoxicity, hepatotoxicity and depression of the central nervous system. Seventy to 80% of phenol absorbed is excreted in the urine 15 to 20 minutes after the application. Tachycardia, ventricular extrasystoles, atrial fibrillation, ventricular fibrillation and electromechanical dissociation may occur. It must be used in a hospital setting due to the mandatory requirement for cardiac monitoring of the patient. Its use should be avoided in cases of heart, kidney, or liver disease, herpes simplex, recent use of isotretinoin, psychological instability, predisposition to keloids, continuous exposure to UV rays, and in skin types IV to VI.

It is a very painful *peeling* due to the phenol's action in the intermediate reticular dermis, requiring sedation and analgesics. It is necessary to maintain good hydration with 0.9% saline, before and during the procedure.

The application is carried out with cotton gauze or cotton swabs. Vigorous friction must be avoided, because it could lead to a very fast penetration and increased risk of toxic overapplication. The application must start in the largest aesthetic unit of the face (the face is divided into six aesthetic units: frontal, nasal, malar, mentum, perioral, and periorbital), with a waiting time of 10 to 15 minutes before applying in subsequent areas.

Partial or complete occlusion of the face with white impermeable tape can be used to increase penetration. The Baker-Gordon solution combined with occlusion penetrates through to the intermediate reticular dermis, and through to the upper reticular dermis without occlusion. The average procedure lasts 60 to 90 minutes, and the patient should be observed for four hours after its completion. It is recommended that the following medicaments be prescribed post-operatively: hypnotics/anxiolytics for rest, analgesics, antibiotics, and ice compresses. Burning sensation and pain may occur for up to eight hours, and there may be accentuated edema as well. The eyelids can even become protruded. The patient should be instructed to return in 24 hours for psychological support, and in 48 hours for the removal of the dressing.[2]

Applications of three to five 3% boric acid compresses should be administered per day, followed by the application of bacitracin cream or vaselinized ointment with antibiotic, or bismuth antiseptic powder for 7 days. Epidermal regeneration begins within 48 hours and should be complete in about 10

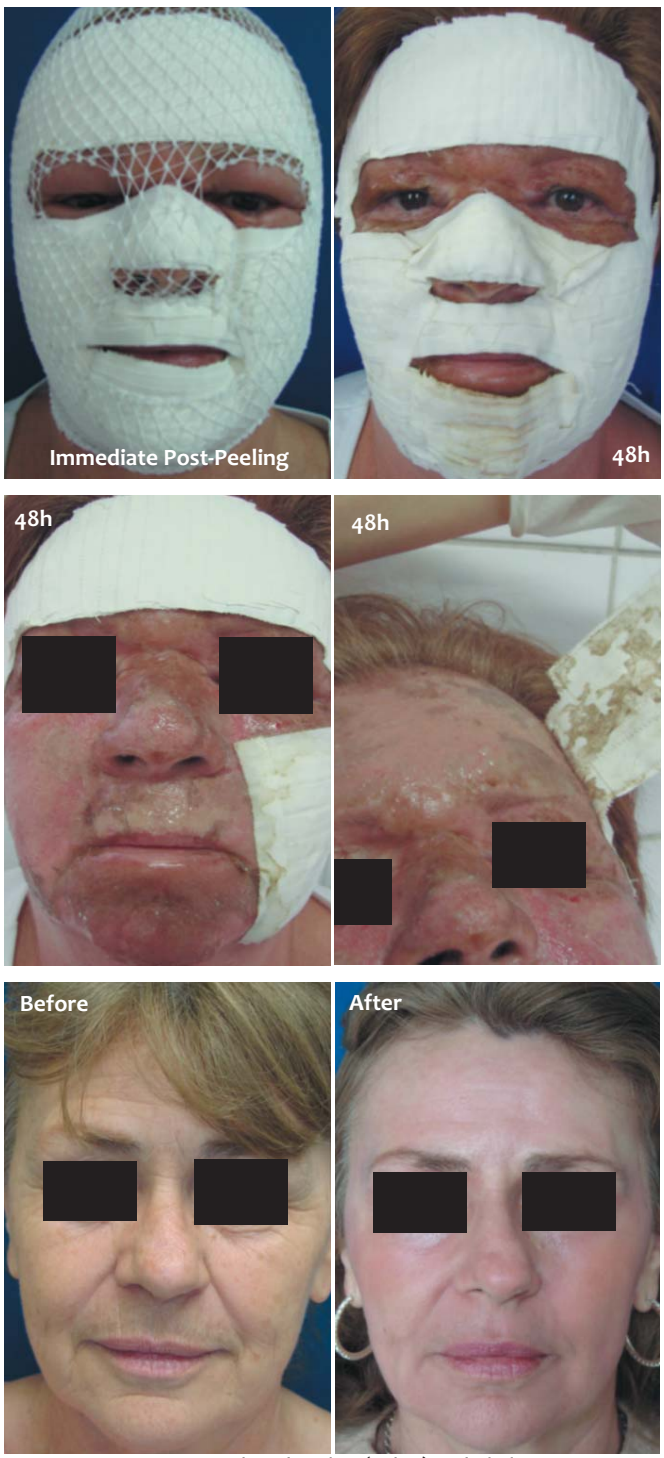

Figure 8: Phenol *peeling* (Baker) occluded

days.[6] Pruritus is a common symptom during the healing process, and can be alleviated with the application of low-strength corticosteroids and ice packs.Erythema and crusting may remain for 14 days. Formation of milia is relatively common, and may disappear spontaneously or by manual extraction (Figure 8).

It is deemed to be extremely effective and must be performed only by physicians.

Punctuated phenol *peeling*

This is new technique aimed at minimizing possible side effects as well as the recovery time. After removing skin oils with alcohol, demarcation lines are drawn in the areas to be treated. 88% phenol is applied in a punctuated way with the aid of cotton swab sticks. This method of application keeps the tissue around each application point untouched. The points can be arranged in rows over the static wrinkles of the face, resulting in whitish spots, which develop into crusts and desquamate within ten days. Neither sedation nor anesthesiais necessary, as the application method is quite tolerable.

Up to five sessions can be appliedin monthly intervals. The clinical findings are similar to those resulting from other *peelings*, i.e. there is a decrease of static wrinkles of the face in the periocular and perioral regions, improvement in the overall texture of the skin, and in the contour of the lips. Histological studies corroborate these observations.[30]

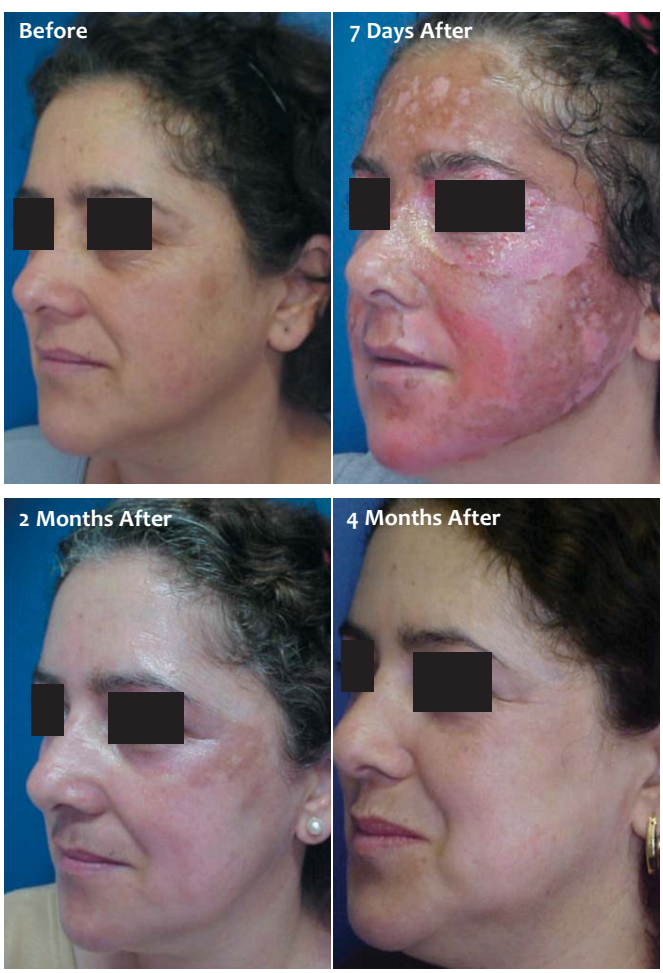

Figure 9: Hyperpigmentation: Jessner + TCA + Baker periorbital

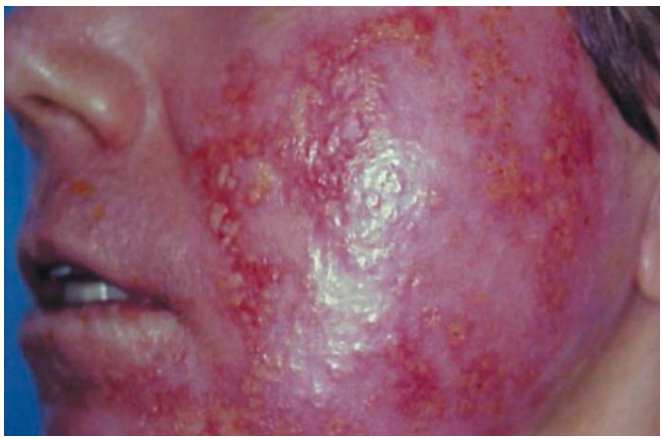

Figure 10: Herpes Simplex, post-medium depth peeling

COMPLICATIONS

Complications vary according to the procedure's type and depth, the skill of the person performing the application and the patient's characteristics.[12,07,31] The most common complications are:

- pigmentary changes: post-inflammatory hyperpigmentation and hypopigmentation. The latter can be very persistent and often difficult to treat. Topical corticosteroids, tretinoin, hydroquinone, or alpha-hydroxy acids can be used (Figure 9)
- infections: bacterial (*Staphylococcus, Streptococcus, Pseudomonas*), viral (herpes simplex) and fungal (candida). Must be treated aggressively and appropriately (Figure 10)
- scars are more frequent after medium depth or deep *peelings*. A proper preparation, the correct choice of *peeling* agent, and post-operative care can help to prevent this complication
- allergic reactions
- milia
- acneiform eruptions
- demarcation lines

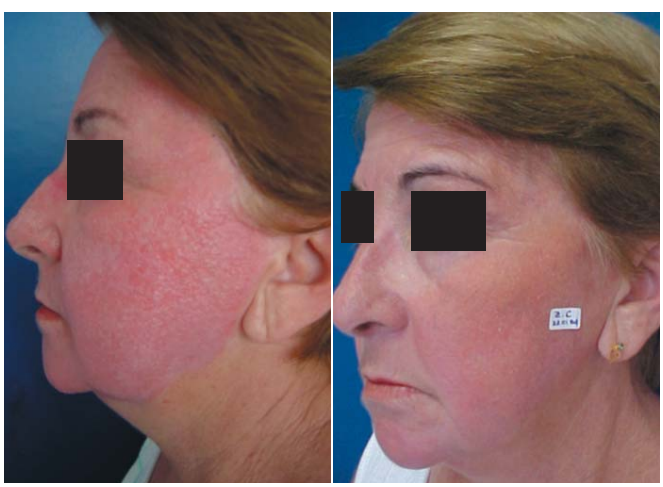

Figure 11: Persistent Erythema

- textural alterations

- persistent erythema: erythema lasting for more than three weeks is indicative of hypertrophic scarring and must be treated with potent topical corticosteroids (Figure 11)

toxicity:it may occur with salicylic acid, resorcinol and phenol[2]

Peelings are contraindicated in cases of pregnancy, lactation, active herpes lesions, bacterial or fungal infection, facial dermatitis, use of photosensitizing medications, allergies to components of the *peeling* formula, and unrealisticexpectations.[30,31]

REFERENCES

1. Oremović L, Bolanca Z, Situm M. Chemical peelings--when and why? Acta Clin Croat. 2010;49(4):545-8.
2. Khunger N. Standard guidelines of care for chemical peels. Indian J Dermatol Venereol Leprol. 2008; 74(Suppl):S5-12.
3. Brody HJ, Monheit GD, Resnik SS, Alt TH. A history of chemicalpeeling. Dermatol Surg. 2000; 26(5): 405-9.
4. Rendon Mi, Berson DS, Cohen JL, Roberts WE, Starker I, Wang B. Evidence and Considerations in the Application of Chemical Peels in Skin Disorders and Aesthetic Resurfacing. J Clin Aesthet Dermatol.2010;3(7):32–43.
5. Levesque A, Hamzavi I, Seite S, Rougier A, Bissonnette R. Randomized trial comparing a chemical peel containing a lipophilic hydroxy acid derivative of salicylic acid with a salicylic acid peel in subjects with comedonal acne. J Cosmet Dermatol. 2011;10(3):174-8.
6. Velasco MVR, Ribeiro ME, Bedin V, Okubo FR, Steiner D. Rejuvenescimento da pele por peeling químico: enfoque no peeling de fenol. An Bras Dermatol. 2004;79(1):91-9.
7. Fischer TC, Perosino E, Poli F, Viera MS, Dreno B. Cosmetic Dermatology European Expert Group. Chemical peels in aesthetic dermatology: an update 2009.J Eur Acad Dermatol Venereol. 2010;24(3):281-92.
8. Handog EB, Datuin MSL, Singzon I. Chemical Peels for Acne and Acne Scars in Asians: Evidence Based Review. J Cutan Aesthet Surg.2012; 5(4): 239–46.
9. Araújo ALN, Pinto SFM, Sobrinho OAP, Sodré RL. Peeling químico: avaliação de ácido glicólico, ácido retinóico e ATA. Rev Cosmet Med Est. 1995;3(3):41-4.
10. Dréno B, Fischer TC, Perosino E, Poli F, Viera MS, Rendon MI, et al. Expert opinion: efficacy of superficial chemical peels in active acne management--what can we learn from the literature today? Evidence-based recommendations. J Eur Acad Dermatol Venereol. 2011;25(6):695-704.
11. Cucé LC, Bertino MC, Scattone L, Birkenhauer MC. Tretinoin peeling. Dermatol Surg. 2001;27(1):12-4.
12. Langsdon PR, Rodwell DW 3rd, Velargo PA, Langsdon CH, Guydon A. Latest chemical peel innovations. Facial Plast Surg Clin North Am. 2012;20(2):119-23.
13. Faghihi G, Shahingohar A, Siadat AH. Comparison between 1% tretinoin peeling versus 70% glycolic acid peeling in the treatment of female patients with melasma. J Drugs Dermatol. 2011;10(12):1439-42.
14. Gold MH, Hu JY , Biron JA, Yatskayer M, Dahl A, Oresajo C. Tolerability and Efficacy of Retinoic Acid Given after Full-face Peel Treatment of Photodamaged Skin. J Clin Aesthet Dermatol. 2011;4(10):40-8.
15. Perić S, Bubanj M, Bubanj S, Jančić S. Side effects assessment in glicolyc acid peelings in patients with acne type I.Bosn J Basic Med Sci. 2011;11(1):52-7.
16. Sarkar R, Bansal S, VK. Chemical Peels for Melasma in Dark-Skinned Patients. J Cutan Aesthet Surg. 2012; 5(4): 247–253.
17. Deprez P. Easy Phytic Solution: A New Alpha Hydroxy Acid Peel with Slow Release and without Neutralization. Int J Cosm Surg Aesth Derm. 2003;5(1):45–51.
18. Kadunc BV. Ácido pirúvico: técnica de padronização para uso em esfoliações químicas através de estudo experimental. [Tese]. São Paulo: Universidade de São Paulo; 1998.
19. Berardesca E, Cameli N, Primavera G, Carrera M. Clinical and Instrumental Evaluation of Skin Improvement afterTreatment with a New 50% Pyruvic Acid Peel. Dermatol Surg. 2006;32:526–31.
20. Grimes PE. The safety and efficacy of salicylic acid chemical peels in darker racial-ethnic groups.Dermatol Surg. 1999;25(1):18–22.
21. Uhoda E, Pierard-Franchimont C, Pierard GE. Comedolysis by a lipohydroxyacid formulation in acne-prone subjects. Eur J Dermatol. 2003;13(1):65–8.
22. Garg VK, Sinha S, Sarkar R. Glycolic acidpeels versus salicylic-mandelicacid peels in active acne vulgaris and post-acne scarring and hyperpigmentation: A comparative study. Dermatol Surg.2009;35(1):59–65.
23. Costa A, Basile AV, Medeiros VLS, Moisés TA, Ota FS, Palandi JAC. Peeling de gel de ácido tioglicólico 10%: opção segura e eficiente na pigmentação infraorbicular constitucional. Surg Cosmet Dermatol. 2010;2(1):29-33.
24. Obagi ZE, Obagi S, Alaiti S, Stevens MB.TCA-based blue peel: a standardized procedure with depth control. Dermatol Surg. 1999;25(10):773-80.
25. Steiner D, Feola C, Bialeski N, Silva FAM, Antiori ACP, Addor FAZ, Folino BB. Estudo de avaliação da eficácia do ácido tranexâmico tópico e injetável no tratamento do melasma. Surg Cosmet Dermatol. 2009;1(4):174-7.
26. Kanechorn Na, Ayuthaya P, Niumphradit N, Manosroi A, NakakesA.Topical 5% tranexamic acid for the treatment of melasma in Asians: a double-blind randomized controlled clinical trial. J Cosmet Laser Ther. 2012;14(3):150-4.
27. Lee JH, Park JG, Lim SH, Kim JY, Ahn KY, et al. Localized intradermal microinjection of tranexamic acid for treatment of melasma in Asian patients: a preliminary clinical trial. Dermatol Surg. 2006;32(5):626-31.
28. Safoury OS, Zaki NM, El Nabarawy EA, Farag EA. A study comparing chemicalpeeling using modified Jessner's solution and 15% trichloroacetic Acid versus 15% trichloroacetic acid in the treatment of melasma. Indian J Dermatol. 2009;54(1):41–5.
29. Hong SP, Han SS, Choi SJ, Kim MS, Won CH, Lee MW, et al. Split-face comparative study of 1550 nm fractional photothermolysis and trichloroacetic acid 15% chemical peeling for facial melasma in Asian skin. J Cosmet Laser Ther. 2012;14(2):81-6.
30. Mendonça MC, Aarestrup FM, Aarestrup BJ. Clinical protocol for punctuated 88% phenol peels in the treatment of photoaging: a histopathological study of three cases. Dermatol Surg. 2012;38(12):2011-5.
31. Berson DS, Cohen JL, Rendon MI, Roberts WE, Starker I, Wang B. Clinical role and application of superficial chemical peels in today's practice. J Drugs Dermatol. 2009;8(9):803-11.