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Chemical peeling in dermatology

Part I. History, definition, classification, description, indications with proofs of efficacy

Nowadays, an ever-growing number of peelings are offered to dermatologists during their daily practice. But all peelings are not the same. Every dermatologist must first make a rigorous selection of the peeling that most accurately complies with his patient's skin and the indication to be treated, secondly he should apply it according to a scientific methodology which is now well established. Pre-peeling and post-peeling are also two crucial phases, which will account for the successful results and for the absence of complications. The latter will be treated in the second part of this paper.

Key words

Chemical peeling, exfoliation, glycolic acid, trichloracetic acid, salicylic acid, phenol peeling.

History of chemical peelings

The ancient Egyptians were using natural products for improving their skin, among them sour milk. When sour milk was used to produce smooth skin, lactic acid, an alpha-hydroxy acid, was the active ingredient [1]. Since modern dermatology appeared in the mid-1800s, the Viennese dermatologist Ferdinand von Hebra was treating freckles and melasma by using various combinations of exfoliative agents [2]. Of interest, in 1882, a German dermatologist, Paul Gerson Unna, described the properties of salicylic acid, resorcinol, phenol and trichloracetic acid [3]. Undoubtedly, Unna was the pioneer of modern peeling, and his formula known as Unna's paste is still in use today. A great revolution was the investigation by Van Scott and Yu of the alpha-hydroxy acids in the late 1970 [4]. Throughout the 1990s, AHAs have been added to the peel spectrum with their promotion by the media, an event unprecedented in the history of chemical peeling [1]. Since then, the popularity of chemical peelings is ever-growing among patients in dermatology.

Definition of chemical peelings

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 [1]. Chemical peeling is the process of applying chemicals to the skin to destroy the outer damaged layers, thus accelerating the normal process of exfoliation [5] followed by the regeneration of new tissues.

Classification of chemical peelings

Peeling agents are classified according to the depth of peel they cause. Many variables can alter the depth of peeling a chemical agent can cause, including the following [5]:

— The nature and concentration of the peeling agent;
— The number of coats applied/length of time the agent is in contact with the skin;
— Technique of application (painted or rubbed in);
— Priming of the skin in the weeks preceding the peel;
— Cleansing and degreasing the skin before the peel;
— Type of patient's skin;
— Anatomical location of the peel.

Peeling agents can be classified as follows [6].

1. Very superficial agents, removing the stratum corneum (depth = 0.06 mm) include the following:
   • Glycolic acid, 30 to 50 %, applied briefly (1 to 2 minutes);
   • Jessner solution, applied in 1 to 3 coats;
   • Low-concentration resorcinol, 20 to 30 %, applied briefly (5 to 10 minutes);
   • TCA 10 %, applied in 1 coat.
2. Superficial agents causing epidermal exfoliation of the granular layer up until the basal layer (depth = 0.45 mm). They include the following:

- Glycolic acid, 50 to 70 %, applied for a variable time (2 to 20 minutes);
- Jessner solution, applied in 4 to 10 coats;
- Resorcinol, 40 to 50 %, applied for 30 to 60 minutes;
- TCA, 10 to 30 %.

3. Medium-depth agents are reaching the papillary dermis (depth = 0.6 mm) and include the following:
   - Glycolic acid 70 %, applied for a variable time (3 to 30 minutes);
   - TCA, 35 to 50 %;
   - Augmented TCA
     – Carbon dioxide plus TCA 35 %;
     – Jessner solution plus TCA 35 %;
     – Glycolic acid 70 % plus TCA 35 %.
4. Deep agents reach the midreticular dermis (depth = 0.8 mm) and comprise of:
   - Phenol 88 %;
   - Baker-Gordon phenol formula.

Description of specific chemical peels

1. Glycolic acid peels

Glycolic acid is the most commonly used AHA as a peeling agent. Glycolic acid is an alpha-hydroxy acid (2-hydroxy-ethanoic) found in sugar cane or synthesized from formaldehyde. Given that it presents a highly variable penetration, it is not suitable for deep peelings, being more frequently used in superficial peelings in concentrations between 30—70 % and sometimes in medium peelings at a concentration of 70 % [6, 7]. 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 [7]. 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 [7]. It can be presented under a water solution or a gel form. They are systemically safe and nontoxic and produce superficial peels capable of significant effects but with few complications. They are also well tolerated by patients [6].

2. Jessner peels

Jessner solution is used for light peels alone or in preparation for a TCA peel. The preparation is made from salicylic acid, 14 g; resorcinol, 14 g; lactic acid (85 %), 14 g; and ethanol to 100 mL. Its shelf life is 2 years if the container is opened only for 5 minutes every month, and it darkens with age and exposure to light and air [6]. The penetration depends on the number of layers, and can be used for medium depth peelings. 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 [7]. The advantages of Jessner solution are that the peel is very superficial and safe and rarely goes deeper than one would expect. A fairly uniform peel is created, and there is a significant amount of exfoliation, which is ideal for treating dyschromias. Concentration of resorcinol is low, and therefore, there is a very low risk of resorcinol toxicity. Disadvantages include erythema and discoloration, which are associated with this peel and which may be quite difficult to cover up with makeup [6].

3. Trichloracetic (TCA) peels

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 100 ml.

4. Lactic acid peels

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.

5. Phytic acid [8]

Phytic acid is not an AHA, but a large molecule of inositol hexaphosphoric acid considered to be an excellent antioxidant. It is also an antityrosinase and binds out iron. Phytic acid produces a poor peeling effect. It has progressive and sequential therapeutic action, in a non-aggressive manner. It does not cause a burning sensation.

6. Salicylic acid peels

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 peelings [7].

7. Pyruvic acid peels

Pyruvic acid is an alpha-keto acid used at concentrations of 50 %, 60 % and 80 %. 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 [7].

8. Retinoic acid peels

Retinoic acid is a metabolite of vitamin A (retinol) that mediates the functions of vitamin A required for growth and development. Retinoic acid peelings are not commonly used, and when employed their concentration is 5 or 10 %.

9. Azelaic acid peels

Azelaic acid is a dicarboxylic acid. Azelaic acid is an important therapeutic agent applied not only in common acne, but also in skin discolorations, mainly in melasma and acne rosacea — the disorders common for ageing women. By inhibiting the activity of neutrophils, it inhibits the production of free radicals and serves as their scavenger. Thus, it has anti-ageing properties [9]. Although its use is not common in peeling, the usual concentration is 20 %. Chemical peels with 20 % azelaic acid are well tolerated [9].

10. Mandelic acid peels

Mandelic acid is an aromatic alpha-hydroxy acid. It is rarely used as a peeling, at a concentration of 40 %. Physical and chemical properties of mandelic acid, slow penetration and therefore, a more effective control of the process of penetration during a procedure and the fact that it is well tolerated by patients with sensitive skin, contributed to the popularity of the acid [9]. Chemical peels with mandelic acid are well tolerated. No immediate or long-term side effects are observed. After the application of mandelic acid, slight exfoliation is observed and remains for 7 up to 10 days [9].

11. Phenol peeling

Phenol, or carbolic acid, is derived from coaltar. 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. Its formula is Phenol: 88 % phenol + + 12 % water (3 ml)/common or distilled water (2 ml)/Soap: liquid hexachlorophene (0.025 %, 8 drops)/Croton oil: (3 drops). Since 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 [7]. The Baker-Gordon formula is a suspension comprising thin particles of solid component dispersed in a liquid medium and should be agitated before use. Its proper use requires prior anamnesis, physical examination, and laboratory tests, given that phenol is absorbed systemically by the skin and may cause cardiotoxicity, nephrotoxicity, hepatotoxicity and depression of the central nervous system. 70 % 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 [7]. 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.

12. Combination peels

Combination peels are used to enhance the penetration of a low-concentration TCA, or other acids, thus minimizing the risks of scarring while the acid still penetrates as deeply as 50 % TCA [5]. The most commonly used combinations are as follows.

a. Jessner solution and TCA (Monheit peel) [10]

This peel combination was described by Cary Monheit. After priming the skin as for other peels, 1 to 4 layers of Jessner solution are applied until there is generalized erythema with areas of light frost. 35 % TCA is then applied, which penetrates more rapidly, uniformly, and deeply than if it were applied on its own, especially if the patient's skin is thick and sebaceous. These peels can be repeated every 3 to 4 months to maintain an improvement of aging fine lines.

b. Solid carbon dioxide and TCA [11]

This combination is used to peel different areas of the skin to different extents. Areas that need deeper peeling are first treated with solid carbon dioxide dipped in a solution of acetone and alcohol to help it glide over the skin. The longer the time and the greater the pressure exerted when applying the solid carbon dioxide, the deeper the peel. When the burning or tingling sensation from the carbon dioxide has subsided, 35 % TCA is applied to the whole face.

c. Glycolic acid and TCA [12]

After normal priming of the skin, 70 % glycolic acid is applied to the skin for 2 minutes without prior cleaning of the skin. TCA 35 % is then applied. This combination is claimed to result in a more uniform and deeper peel than TCA used alone.

Indications and efficacy of chemical peelings

1. Glycolic acid peels

GA peels are indicated for active acne, acne scars, melasma, post-inflammatory hyperpigmentation, photoaging, mild dermatoheliosis [13] and nail rejuvenation [14]. There is an improvement of mottled hyperpigmentation and fine wrinkling, but significant wrinkling and dark pigmentation are usually resistant to the treatment. GA peels can be applied not only on the face, but also to other sun-damaged areas including the neck, chest, and dorsum of the hands [5].

a. Acne

In a study [15], Asian patients with acne with skin type IV were treated with 35 % GA and 50 % GA peels, once in 3 weeks for 10 weeks. There was a significant resolution of comedones, papules, and pustules. The skin texture improved and follicular pore size reduced. Most of the patients were found to have brighter and lighter looking skin. Consistent and repetitive treatment with GA was needed for the apparent improvement of cystic lesions. Only a small percentage of patients (5.6 %) developed side effects, in the form of post-inflammatory hyperpigmentation, mild skin irritation, and exacerbation of herpes simplex infection. Hence, GA peels were found to be ideal as an adjunctive treatment for acne. In another study [16] 70 % GA was used in comedonic acne, papulopustular, and nodular/cystic acne. While comedones improved rapidly, papulopustular acne improved after six peel sessions, and nodulocystic lesions required ten sessions at three-week intervals. A significant improvement of coexisting post-acne superficial scarring was noted. Patient tolerance and compliance were both found to be excellent.

S.W. Kim et al. [17] did a comparative study using 70 % GA and Jessner's Solution, respectively, in two groups of patients with acne. Three peel sessions were done for each group. Though acne improved in both to the same extent, there was more exfoliation seen in the Jessner's Solution group. Hence, GA was found to be the better tolerated of the two peels for the treatment of acne in Asian patients. In a study of 41 patients with Fitzpatrick Skin Type III—V [18], of whom 16 patients had acne, initially 10 % GA was used for a period of 1—2 minutes, then the duration gradually increased to 5 minutes and concentration to 30 % GA. The therapeutic response was good in 75 % of patients, on the basis of both patient and observer assessments. Significant decrease in the number of comedones and papulopustules was observed in patients with mild to moderate acne. However, the patient with nodulocystic acne lesions did not respond well to therapy. E. Kessler et al. [19] compared 30 % GA versus 30 % salicylic acid (SA) peels in 20 patients with mild to moderate acne. Peels were performed every 2 weeks for a total of six treatments. Both peels improved acne. However, the authors found that the SA peel had better sustained efficacy and fewer side effects than GA. SA peels were better tolerated than GA peels in these patients.

b. Acne scars

Z. Erbağci and C. Akçali [20] concluded that a 70 % GA peel performed every 2 weeks resulted in significant improvement in atrophic acne scarring, as compared to 15 % GA cream used daily.

c. Melasma

Significant improvement was observed in melasma and fine facial wrinkles with 20–70 % GA administered every 3 weeks, in combination with a topical regimen of daily 2 % hydroquinone plus 10 % GA [21]. In a study, peeling was performed upon 15 Indian females with melasma, using 50 % GA, once-monthly for 3 months. An improvement in Melasma Area Severity Index (MASI) score was observed in 91 % of patients and a better response was seen in patients with epidermal melasma, compared to those with mixed melasma [22]. In another study [23], 20 Indian patients received serial GA peels (30 % GA for the first three sittings; 40 % GA for the next three sittings), combined with the modified Kligman's formula (2 % hydroquinone, 0.025 % tretinoin, and 1 % mometasone). A further 20 Indian patients received only the modified Kligman's formula, with no peeling. In both groups, a significant decrease in the MASI score was observed from baseline to 21 weeks. However, the GA peel group showed more rapid and greater improvement. In a study where patients with melasma were treated with a 70 % GA peel on one half of the face, while the other half was treated with a 1 % tretinoin peel, a significant decrease in the modified MASI score was observed on both facial sides from baseline to 6 weeks, and then from 6 to 12 weeks [24]. D.E. Kligman also found the two peels to be equally effective and well tolerated [25]. In a previously reported study [18], in 15 cases of melasma (epidermal: 80 %; dermal: 13.3 %; and mixed: 6.6 %), 52.5 % GA concentration was applied for 3 minutes. There was good to fair response in patients with epidermal and mixed melasma, while no significant improvement was seen in dermal melasma. In a comparative study

of 10–20 % TCA versus 20–35 % GA peels for the treatment of melasma, similar improvement was seen with both peels. However, the GA peel was seen to be associated with fewer side effects than the TCA peel, and gave the added benefit of facial rejuvenation [26].

d. Post-inflammatory hyperpigmentation

In a pilot study [27], post-inflammatory hyperpigmentation was treated with a series of GA peels on skin types IV—VI. No adverse effects were reported in dark skin, and the GA peel proved to be efficacious. This echoed the study already mentioned [18] in which skin types III—V showed overall improvement of skin texture in almost all patients.

e. Photoaging

Photodamage, in the form of dyschromias, actinic keratoses, solar lentigines, and fine wrinkling has also shown improvement with a combination of GA and TCA peels [28, 29]. Upon treatment with serial 50 % GA peels [30, 31], there was improvement in the mild photoaging of skin. Other significant improvements were noted, including decreases in rough texture and fine wrinkling, fewer solar keratoses, and slight lightening of solar lentigines. Histologic analysis showed thinning of the stratum corneum, granular layer enhancement, and epidermal thickening. Some specimens even showed an increase in collagen thickness in the dermis.

f. Nail rejuvenation

In a study of 31 patients, 22 with dry, rough, discolored nails and 9 with hyperkeratotic nails [14] petroleum jelly was applied on the cuticle margins of the nails for protection and 70 % glycolic acid was applied over the nail plate for 45 minutes. In 22 patients with dry rough nails, 80 % showed good improvement, 10 % showed average improvement, whereas 10 % were nonresponsive. Nine patients with thickened nail plate showed good improvement in 60 %, average improvement in 25 %, and 15 % were nonresponsive, after multiple sessions.

2. Jessner peels

Jessner peel (JP) can be used in various indications, such are seborrhea and acne, mild hyperpigmentation, moderate actinic keratosis, moderate hyperkeratosis, moderate to severe chrono-aging and moderate to severe photo-aging.

a. Seborrhea and acne

In a previously reported study [17] comparing JP vs. GA 70 % in patients with facial acne in a split-face study (n = 26), efficacy was similar between the two types of peels, but JP was associated with a significantly greater degree of exfoliation compared with GA. However, JP performed twice at an interval of two weeks in 38 patients (27 % GA, 11 % Jessner's solution), and measuring sebum levels, sebum secretion after two peels was unchanged [32].

b. Mild hyperpigmentation

In a study [33], 30 patients with epidermal melasma were treated by 6 sessions of JP at 2-weekly intervals. Difference between pre and posttreatment MASI score was highly significant while adverse effects were mild.

c. Actinic keratosis (AK)

Fifteen patients with severe facial actinic damage and AK on the face were treated with a single application of JP [34]. Evaluations were conducted before treatment and at 1, 6, and 12 months after treatment. This treatment reduced the number of visible AK by 75 % and produced equivalent reductions in keratinocyte atypia, hyperkeratosis, parakeratosis, and inflammation, with no significant alteration of preexisting solar elastosis and telangiectasia.

3. Trichloracetic (TCA) peels

The main indications of TCA are photo-aging, fine lines, wrinkles, pigmentary disorders, superficial atrophic scars, actinic keratosis and rosacea [35].

a. Photo-aging

A medium-depth chemical peel with 40 % TCA alone produced moderate improvement in some manifestations of actinic damage but had little effect on wrinkles [36]. In another study [37], twenty female patients affected by photodamage were treated with graded concentrations of 15 % TCA peel. Each patient was submitted to 5 sessions of these peels, with an interval of 14 days between each session. Elasticity and hydration were found to be significantly increased at the end of the treatment. In a study in photoaged hairless mice [38], after inducing photoaged skin in hairless mice by repetitive ultraviolet-B irradiation applied over 14 weeks, TCA 30 % and TCA 50 % were applied on areas of the same size on the backs of the mice. Punch biopsies were obtained 7, 14, 28, and 60 days after the procedure for histologic and immunohistochemical analyses. An increase in dermal thickness, collagen fibers, and elastic fibers was observed in the dermis of intervention groups compared with control groups. These increases were maintained significantly for 60 days.

b. Pigmentary disorders

An analysis of 106 patients was conducted with benign pigmented lesions who were treated using focal TCA peel [39]. Seborrheic keratosis was treated with 65 % focal TCA peel, solar

lentigines, and freckles with 50 to 65 % focal TCA peel, and melasmas with 10 to 50 % focal TCA peel. Patients had Fitzpatrick skin types IV—V. Patient treatment data indicated that 83 % of patients with seborrheic keratosis, 86 % of patients with solar lentigines, 58 % of patients with freckles, and 55 % of patients with melasma experienced a good clinical response, and no significant complications were reported. In a aforementioned study [26], twenty non-pregnant female patients with a minimum melasma area and severity index (MASI) of 10 were advised to carry out a prepeel program of daily application of 12 % GA cream or 0.1 % tretinoin at night for 2 weeks and then treated with graded concentrations of 10—20 % TCA. Objective response to the treatment evaluated by reduction in MASI scoring after 12 weeks was by 73 %. Patients with epidermal-type melasma showed a better response to the treatment than those with mixed-type melasma.

In another report [40], fifteen patients with melasma aged between 20 and 50 years were treated with 15 % TCA and there was a significant improvement in 64 % of them. In a split-face comparative study of 70 % TCA and 80 % Phenol in the treatment of freckles [41], twenty patients of Fitzpatrick type II—IV were treated. The freckles on the left side of the face were treated with phenol, while those on the right were treated with TCA in all patients. 75 % of patients noted a complete clearance (90—100 % lightening) of lesions treated. Four patients (darker skin types) noted hyperpigmentation, and one noticed recurrence where TCA was applied. Both TCA and phenol were found to be equally effective in the treatment of freckles in fair skin. On the other hand [42], chemical peeling with both TCA 15 % and GA 50 % were found to be safe and effective for the treatment of frictional dermal melanosis. TCA was found to be marginally superior to glycolic acid. Finally, six females with acanthosis nigricans lesions were included in a pilot study [43]. All patients received chemical peeling sessions using TCA 15 % over the affected skin lesions. Sessions were carried out to all patients once per week. Treatment was continued for 1 month. All patients showed improvement as regard to hyperpigmentation, thickening, and overall appearance. The physician assessment was excellent in three lesions, moderate in five, and was mild in two. No side effects had been reported.

c. Superficial atrophic scars

In fifty patients with atrophic acne scars, after subcision, dermaroller and 15 % TCA peel were performed alternatively at 2-weeks interval for a total of 6 sessions of each. Out of 16 patients with Grade 4 scars, 62.5 %) improved to Grade 2 and 37.5 % improved to Grade 3 scars. Out of 22 patients with Grade 3 scars, 22.7 % were left with no scars, 9.1 % improved to Grade 1 and 68.2 % improved to Grade 2. All patients with Grade 2 scars were left with no scars [44].

d. Actinic keratosis (AK)

28 patients with at least 5 AK in two comparable anatomical areas on the head were treated with 35 % TCA and 20 % aminolevulinic acid PDT (ALA PDT) randomly assigned to each area. Therapeutic efficacy, adverse events and cosmetic outcome were assessed by a blinded investigator at 1, 3, 6 and 12 months after treatment [45]. After 12-months follow up TCA and ALA PDT reduced the total lesion count, the primary outcome, by 31,9 and 58,0 %, respectively. Complete clearance of pre-existing AK were 48,8 % for TCA and 73,7 % for ALA PDT. Treatment failure (Number of AK greater than 50 % of the baseline count) was observed in 7 patients (25 %) after TCA and in 2 patients (7,1 %) after PDT treatment. These results show that ALA PDT provided better clinical results than TCA in the treatment of patients with extensive field cancerisation and multiple AK.

e. Rosacea

Fifteen female patients with papular-nodular lesions and refractory to the usual treatment for rosacea underwent a single session of medium depth peel with the application of JP followed by 35 % TCA [46]. All patients who underwent a session of medium depth peel showed an improvement in papular-nodular lesions. However, no satisfactory response was obtained in the reduction of erythema and facial telangiectasias. In all patients treated, the improvement was long lasting.

4. Lactic acid peels

The indications for lactic acid (LA) peels are mainly pigmentary disorders, skin-aging and superficial scarring.

a. Pigmentary disorders

In twenty patients with melasma, pure lactic acid, full strength (92 %; pH 3.5), was used as a peeling agent. The chemical peeling sessions were done every 3 weeks until the desired response was achieved, but not more than six sessions. Follow-up was carried out for 6 months after the last session. All patients had skin type IV [47]. All 12 patients who completed the study showed marked improvement, as calculated by the MASI score before and after

treatment, and the response was statistically highly significant. No side effects were recorded in all treated patients. In another trial [48], 52 patients with typical clinical features of lifa disease (frictional dermal melanosis) were included. Full strength lactic acid (92 %, pH 3.5) was used as a peeling agent. The treatment sessions were done every 2 weeks until the desired response was achieved (but not more than 6 sessions). The pigmentation was improved in all patients as revealed by objective and subjective methods, and this response was statistically highly significant. No significant side effects were recorded in all treated patients. On the other hand, a combination of TCA 3.75 % and lactic acid 15 % was tested on improving the periorbital hyperpigmentation [49]. Thirty patients with periorbital dark circles and skin types II, III, or IV were included in the study. Chemical peeling was performed every week for a series of four treatments. Almost all the patients showed significant aesthetic improvement. Physicians assessed a fair, good, or excellent improvement in 93.3 % of the patients. Patient's global assessment rated a fair, good, or excellent response in 96.7 % of the patients. The procedure itself had only mild and temporary adverse effects, such as erythema, oedema, frosting, dryness, and telangiectasias. The effects of treatment remained for at least 4—6 months in the majority of patients with appropriate sun protection. On twenty patients with melasma, 82 % Lactic acid peel was applied on the face for 12 weeks [50]. Application of this peel for 12 weeks significantly decreased the melasma area severity index score and also melasma severity scale score. Regarding the adverse effects, burning sensation was the only side effect noted in this study.

b. Skin-aging

Comparing LA 85 % vs. GA 70 % in the treatment of fine lines and wrinkles, applications were carried out once a month for three months on the patients' face [51]. For LA, there was significant improvement after the second peeling application on the outer lateral area of the right eye and after the third application on the outer lateral area of the left eye. For the GA group, there was significant improvement in the outer lateral area of the left eye after the first application, and of the right eye region, after three applications.

c. Superficial scarring

Seven patients, Fitzpatrick skin type IV—V, in age group 20—30 years with superficial acne scarring were enrolled in a study [52]. Chemical peeling was done with full strength pure lactic acid 92 % (pH 2.0) at an interval of 2 weeks to a maximum of four peels. At the end of 3 months, there was definite improvement in the texture, pigmentation, and appearance of the treated skin, with lightening of scars. Significant improvement (greater than 75 % clearance of lesions) occurred in one patient (14.28 %), good improvement (51—75 % clearance) in three patients (42.84 %), moderate improvement (26—50 % clearance) in two patients (28.57 %), and mild improvement (1—25 % clearance) in one patient (14.28 %).

5. Phytic acid peels

Phytic acid (PA) peels are mainly recommended for hyperpigmentary disorders, but there is a paucity of clinical data. In the unique published paper that we found [53], ninety patients diagnosed with melasma were randomly assigned into 3 groups of 30 patients each. Group A received GA 35 % peel, Group B received SA 20 %/MA 10 % peel, and Group C received PA 50 % peel. Each group was primed with 4 % hydroquinone and 0.05 % tretinoin cream for 4 weeks before treatment. Chemical peeling was done after every 14 days in all groups until 12 weeks. Objective response to treatment evaluated by reduction in MASI scoring after 12 weeks was 62.36 % reduction in GA group, 60.98 % reduction in SM group, and 44.71 % in phytic acid group.

6. Salicylic acid peels

Salicylic acid (SA) as a peeling agent has a number of indications, including acne vulgaris, melasma, photodamage, freckles, and lentigines.

a. Acne vulgaris

The first report [54] evaluated the effects of SA 30 % histologically in mice and its safety and efficacy in 44 volunteers with normally aged skin and in 436 patients with acne. Histologic studies in animals showed no inflammatory changes in the skin following topical application of SA 30 %. Volunteers noted an improved skin texture. In the acne patients, the comedones and papules disappeared, resulting in an excellent outcome. There was a notable absence of stinging and burning, oedema, bleeding, or crusting in the treated area. Further, a total of 40 patients with mild-to-moderate acne vulgaris were enrolled for 12 weeks and were randomly divided into two groups: group 1, 30 % SA peels and group 2, JS peels were performed 2 weeks apart with total of six peels in 12-week duration [55]. At the end of therapy, improvement in Michaelsson Acne Score (MAS) and percentage decrease in MAS were significantly higher in group 1 as compared to group 2. Likewise, decrease in

mean comedone counts in group 1 was significantly higher as compared to group 2. However, there was no statistically significant difference in the decrease in mean papule and pustule counts between the two groups. Both the groups tolerated the peels well. These results indicate that 30 % SA peels were more effective than JS peels in treatment of non-inflammatory lesions, that is, comedones and in overall improvement of mild-to-moderate facial acne vulgaris. Comparing the effectiveness of two acne vulgaris treatments in adolescents: SA 10 % peel and phototherapy, twenty-two adolescents were divided in two equal groups, one treated with phototherapy, using 470 nm (± 10 nm) blue LED and 660 nm (± 10 nm) low-level red laser for three minutes during ten sessions, and the second receiving SA 10 % peel once a week during ten sessions [56]. Both techniques were effective therapies for the treatment of acne in teenagers since the number of comedones, papules and pustules decreased significantly at the end of the sessions. However, when the two treatments were compared, phototherapy showed a significant difference in reducing the number of pustules in favour of phototherapy.

b. Pigmentary disorders

In a comparison of the efficacy of SA 30 % peel with JP in melasma, sixty patients with epidermal melasma were randomly divided into two groups. Group A was treated with JP and Group B with 30 % SA every two week during six sessions [33]. Difference in baseline, treatment end and follow-up end MASI scores was not statistically significant between the two groups. On the other hand, within group analysis of difference between pre and posttreatment MASI score was highly significant in both groups. Adverse effects were mild and comparable in both groups.

7. Pyruvic acid (PA) peels

Common indications of PA peels are acne, mild actinic keratosis, moderate chrono-aging and moderate photo-aging.

a. Acne

To evaluate the efficacy and tolerability of PA 40—50 % peel for treatment of mild to moderate papulo-pustular acne, a study was conducted in forty patients treated with PA 40—50 % peel every 2 weeks for a total of 3—4 months [57]. Complete remission was observed in 16 patients (40 %), partial remission was detected in 20 patients (50 %), and no improvement was seen in four patients (10 %). No side-effects were observed during or after treatment. Post-treatment evaluation of sebum production revealed a reduction in sebum levels in all patients. In a prospective single-blinded clinical trial, 86 patients with acne were randomly assigned into two groups [58]. In both groups, the routine treatment of acne (topical solution of erythromycin 4 %, triclorocarban soap, and sunscreen) were used twice a day for 8 weeks. In addition, salicylic acid 30 % for the control group and pyruvic acid 50 % for the case group were used. In both groups, the reduction in the number of comedones, papules, and Acne Severity Index (ASI) were statistically significant in the course of treatment. However, it was not significant regarding the number of pustules.

b. Chrono-aging

The aim of a study was to assess the efficacy and tolerability of 50 % PA for the treatment of photodamage, superficial scarring, and melasma [59]. Instrumental evaluations showed a significant reduction in the degree of pigmentation in patients with melasma, a significant increase in skin elasticity, and an improvement of the degree of wrinkling in all the twenty patients in which four peeling sessions were performed once every 2 weeks.

c. Photo-aging

To evaluate the efficacy and tolerability of 50 % PA on moderately photo-damaged facial skin, 20 patients were treated with four peeling sessions at 4-week intervals [60]. The clinical evaluation of the patients after the peeling sessions demonstrated a smoother texture, less evident fine wrinkles, and evident lightening of hyperpigmentations (freckles and lentigines). The patients treated reported very limited or no discomfort in the postpeel period.

8. Retinoic acid peels

Retinoic acid (RA) peels are mainly recommended in photo-aging and melasma.

a. Photo-aging

In order to show the clinical and histologic modifications of the skin after five sessions of RA 1—5 %, 15 female patients with photo-aged skin received this peeling twice a week for 6 weeks [61]. Clinical improvement was observed in the skin texture and appearance. Through histologic examinations, a decrease in the corneous layer and an increase in the epidermal thickness were noticed, inducing an improvement of its stratification, as well as the formation of cristae cutis.

b. Melasma

A pilot study was conducted to evaluate the efficacy and side effects of RA 1 % vs. GA 70 %

in the treatment of melasma in Indian women [62]. RA 1 % peel was applied on one-half of the face, whereas 70 % GA was applied on the other at weekly intervals during 12 weeks, in ten patients. A significant decrease in the modified Melasma Area and Severity Index from baseline to 6 weeks and then from 6 to 12 weeks was observed on both facial sides. Nevertheless, there was no statistically significant difference between the right and the left sides. Side effects were minimal and 1 % tretinoin peel appeared to be well tolerated by the patients. In another study, twenty female patients with bilateral epidermal melasma underwent a daily evening full facial application of 0.025 % tretinoin cream. One week after treatment, was performed facial application of a RA 10 % mask with a tongue depressor and subsequent removal after 1 h. The treatment protocol consisted of four sessions at three-week intervals [63]. Physician global evaluation showed moderate or marked improvement of melasma in all patients using three parameters of assessment: digital photography, mexameter measurement, and the MASI. A particular high tolerability and efficacy without adverse events was noted. Another trial aimed to compare the effects of 5 % and 10 % RA peels in patients with melasma, using the Melasma Area and Severity Index and the Melasma Quality of Life Scale to evaluate the clinical and quality of life impacts, respectively [64]. Patients (n = 30) were randomized to receive either 5 % or 10 % RA peels in weeks 0, 2, 4 and 6 of the treatment. In a global evaluation of the two groups, there was a statistically significant improvement in scores from baseline to week 8, yet there were no statistically significant differences between treatment groups.

9. Azelaic acid peels

To the best of our knowledge, there is a unique indication for azelaic acid peels: decrease of sebum secretion with aging. To compare the influence of azelaic and mandelic acid peels on facial sebum secretion in mature women aged 49—71 years, eleven women were treated with 20 % azelaic acid peel and 17 with 40 % mandelic acid peel [65]. Each of the peels was applied five times with 2-week intervals. A significant increase in sebum secretion was observed in the U-zone after the application of both peels. Neither peel significantly affected sebum secretion in the T-zone.

10. Mandelic acid peels

Besides the aforementioned indication, another good indication of mandelic acid (MA) peels would be melasma. Ninety patients diagnosed with melasma were randomly assigned in a study into 3 groups of 30 patients each [53]. Group A received GA-35 % peel, Group B received SA 20 %/MA 10 % peel, and Group C received PA 50 % peel. Each group was primed with 4 % hydroquinone and 0.05 % tretinoin cream for 4 weeks before treatment. Chemical peeling was done every 14 days in all groups until 12 weeks. Objective response to treatment evaluated by reduction in MASI scoring after 12 weeks was 62.36 % reduction in GA group, 60.98 % reduction in SM group, and 44.71 % in phytic acid group.

11. Phenol peeling

Phenol peelings are usually reserved for attenuation and removal of deep wrinkles and rhytides and acne scarring. Park et al [66] used a modified phenol peel, which was applied to patients of Asian descent, 11 of whom were treated for acne scarring and 28 for wrinkles. All patients with wrinkles improved 51 % or more and their average improvement score was 3.64 out of 4.00. Seven of 11 patients (64 %) with acne scars improved 51 % or more and their average improvement score was 2.73 out of 4.00. The most frequent side-effect was post-inflammatory hyperpigmentation (74 %).

12. Combination peels

a. Jessner solution and TCA (Monheit peel)

This peeling combination was first described by Monheit [10] who was recommending it for for photoaging skin, actinic keratoses, and rhytides. Acne scars also appear to be a valuable indication. The aim of a recent study was to compare the efficacy of 20 % TCA and Jessner's solution versus 20 % TCA alone for the treatment of acne scars [67]. 50 patients with acne scars were divided into two groups of 25 patients each. Chemical peeling was done in both the groups. In Group I, chemical peeling with Jessner's peel followed by 20 % TCA was done and in Group II patients chemical peeling with 20 % TCA peel alone was done. In Group I, mild improvement of acne scars was seen in 8 % cases, moderate improvement in 32 % cases and marked improvement of acne scars was seen in 60 % patients. In Group II, mild improvement of acne scars was seen in 32 % cases, moderate improvement in 40 % cases and marked improvement of acne scars was seen in 28 % patients.

b. Glycolic acid and TCA

In a controlled, prospective study to compare the efficacy of a focal medium-depth chemical peel regimen using 70 % GA and 35 % TCA with cryosurgery, in the treatment of solar

lentigines of the hands, twenty-five patients were treated with either focal medium-depth chemical peel or cryosurgery, which was randomly assigned to the left or right hand [68]. Taking into account the results, it was suggested that treatment of the solar lentigines with a focal medium-depth chemical peel may be clinically superior to treatment with cryosurgery, due to the paucity of side effects, such as hypopigmentation and pain, associated with the chemical peel regimen. A controlled chemical peel technique for nonfacial skin using 70 % GA combined with 40 % TCA has given consistently good results on the skin of the neck, chest, arms, hands, back, and other nonfacial skin [69]. Further to application of 70 % GA to the entire face, diluted with water after 2 minutes and immediate application of 35 % TCA, the improvement in pigmentary dyschromias and actinic damage was impressive [12].

Conclusions

Chemical peeling is a long practice, appeared much before the occurrence of dermatology.

The latter occurred in the mid-1800s and immediately, some practices of chemical peelings were described and reported. They were later developed and enriched, till the advent and popularity of the chemical peelings with AHAs in the late 1970. Peeling, which means stripping off or removing of external layer(s) of the skin can be reach various levels, from the superficial epidermal one (stratum corneum) till the midreticular dermis. Chemical peelings are classified in function of their depth of action. Nowadays exist lots of possibilities for the dermatologist, with a long list of active ingredients, the most popular peelings being certainly with glycolic acid and trichloracetic acid at various strengths. Indications of chemical peelings are also various, ranging from cosmetic aims such as photo-aging, chrono-aging, to true medical indications such as acne or melasma. A bulk of literature is available in order to support these different chemical peelings.

In part II of this paper we shall describe in details the methodology of use of each of these peels, but also the complications susceptible of occurring when performing them, and their adequate management.

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Хімічні пілінги в дерматології Частина І. Історія, визначення, класифікація, опис, показання з доказами ефективності

У наш час зростає кількість пілінгів, які пропонують дерматологи у своїй повсякденній практиці. Але не всі пілінги однакові. Кожен дерматолог повинен спочатку чітко обрати пілінг, який найбільш точно відповідає шкірі пацієнта й показанням до лікування, по-друге, він повинен застосувати його у відповідності з науковою методологією, яка в даний час добре розроблена. Препілінг та постпілінг є також двома важливими фазами, які будуть відповідати за успішні результати й відсутність ускладнень. Останнє буде розглядатися у другій частині цієї статті.

Ключові слова: хімічний пілінг, ексфоліація, гліколева кислота, трихлорацетилова кислота, саліцилова кислота, феноловий пілінг.

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Химические пилинги в дерматологии Часть I. История, определение, классификация, описание, показания с доказательствами эффективности

В наше время увеличивается количество пилингов, которые предлагают дерматологи в своей повседневной практике. Но не все пилинги одинаковы. Каждый дерматолог должен сначала четко выбрать пилинг, который наиболее точно соответствует коже пациента и показаниям к лечению, во-вторых, он должен применить его в соответствии с научной методологией, которая в настоящее время хорошо разработана. Препилинг и постпилинг – это тоже две важные фазы, которые отвечают за успешные результаты и отсутствие осложнений. Последнее будет рассматриваться во второй части этой статьи.

Ключевые слова: химический пилинг, эксфолиация, гликолевая кислота, трихлорацетиловая кислота, салициловая кислота, феноловый пилинг.

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