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Review article

Peeling agents: toxicological and allergological aspects

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Abstract

Background The use of peeling agents is very common in clinical practice. However, despite the overall good safety profile, it is not without any inherent risk; therefore, clinicians should be adequately informed about potential risk in order to avoid or prevent them.

Objective This paper reviews toxicological and allergological aspects of peeling agents in general, also beyond their actual use in peeling procedures. Toxic and allergic reactions from peeling agents are rather uncommon and have been rarely reported in association with the medical use of peels.

Methods Systemic toxic effects may essentially derive from phenol and potentially from two phenol derivatives, resorcinol and salicylic acid. A complete understanding of the toxicological profile of peeling agents, along with a correct execution of the technique and a carefully selection of patients, can help avoid serious side effects.

Results Allergic contact reactions occur most frequently with resorcinol, while most peeling agents are only rare sensitizers or appear to be free of true sensitizing power. Other types of hypersensitivity response seem to be very rare.

Keywords: Peeling agents; Side effects; Toxicity; Allergic reactions

1. Introduction

Peeling procedures consist of the application of one or more exfoliating agents to the skin, resulting in controlled destruction and subsequent regeneration of portions of epidermis or dermis with long-lasting therapeutic or cosmetic results.

Of the main peeling agents (listed in Table 1), tretinoin, azelaic acid and 5-fluorouracil can produce very superficial peels only after repeated use, while the others act as true peeling agents [1–5]. The wide use of chemical peeling in dermatology has contributed to improve and clarify many aspects of the procedure, such as mechanism of action, technical modalities, indications, patient selection and safety profile. Cutaneous changes caused by peeling agents are directly related to the depth of the wound which, in turn, can also influence the risk of some local complications. Moreover, other untoward effects, particularly toxic and allergic reactions, more strictly depend on chemical features of the exfoliating substance. Possible complications related to the topical use of peeling agents are summarized in Table 2 [1–4]. Local complications are exhaustively discussed in several reviews, to which the reader is referred for further details; this paper deals only with toxicological and allergological aspects. In order to evaluate such

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Table 1
Classification of peeling agents

Superficial peeling agents (wound depth up to papillary dermis)
Tretinoin
Azelaic acid
Solid carbon dioxide (CO_2)
Salicylic acid
alpha-Hydroxy acids
5-Fluorouracil
Resorcinol
Jessner's (resorciniol/salicylate/lactate) solution
Trichloracetic acid (TCA) 10–35%
Medium-depth peeling agents (wound depth up to upper reticular dermis)
TCA 50%
Glycolic acid 70%
Pyruvic acid
Full-strength phenol, 88%, unoccluded
Combination CO_2 + TCA, 35–50%
Combination Jessner's + TCA
Combination 70% glycolic acid + TCA 35%
Deep-depth peeling agents (wound depth up to midreticular dermis)
Baker's phenol, unoccluded or occluded

Table 2
Possible complications related to the topical use of peeling agents

Local complications:
Pigmentary changes
Scarring
Infections
Persistent erythema or pruritus
Textural changes
Atrophy
Milia and acneform eruptions
Ecchymoses
Increased sensitivity of skin to sunlight, wind and temperature changes
Allergic reactions:
Contact allergy
Cold urticaria/sensitivity
Cholinergic urticaria
Contact urticaria
Toxic reactions:
Cardiac arrhythmias
Laryngeal edema
Toxic shock syndrome
'Salicylism'
Ochronosis
Hypothyroidism
Methaemoglobinaemia
Hypotension up to collapse
Others

aspects in the most complete possible way, this review refers to peeling agents in general, also beyond their actual use in peeling procedures.

Toxic and allergic reactions to peeling agents are rather uncommon and have been rarely reported in association with the medical use of peels. However, clinicians, especially dermatologists, who want to perform chemical peels should be informed about these aspects.

2. Leading peeling agents

2.1. Resorcinol (resorcin)

Resorcinol (m-dihydroxybenzene) exhibits keratolytic, antipruritic and antiseptic activities. Several sources of exposure to resorcin are known (Table 3). Resorcinol is also contained in some chemical peels, shown in Table 4.

2.1.1. Allergenicity

Structurally related to phenol and isomerically with catechol and hydroquinone, it can give rise to an aspecific irritant contact dermatitis, while its sensitizing power seems to be only moderate [6]. Compounds which can cross-react with resorcinol are reported in Table 5 [6–8]. A few cases of contact allergy to resorcinol from various sources have been described [8–

Table 3
Sources of exposure to resorcin

Acne preparations
Antipsoriatic topical preparations
Castellani's paint
Hair tonics
Hair dyes
Textile dyes
Color developers
Photocopy machines
Plastics
Lipsticks
Eyedrops
Cosmetics
Suppositories
Chemical peels

Table 4
Resorcinol peels

Jessner's solution (Combes' formula)	Letessier's modified Unna's paste
Resorcinol 14 g	Resorcinol 40 g
Salicylic acid 14 g	Zinc oxide 10 g
Lactic acid (85%) 14 g	Ceyssatite 2 g
Ethanol (95%) q.s. ad[a] 100 cc	Benzoinated axungia 28 g

[a] q.s ad, quantity sufficient to add up to.

20]. Although contact sensitization appears to be rare, patch testing a few days before the peel is mandatory [21,22]. According to Rubin, the compound can be applied in the postauricular area for 15 min and the reaction should be examined 48 h later. Any sign of vesiculation or relevant erythema implies possible contact sensitivity and consequently the necessity of avoiding resorcinol peels [2]. A contact dermatitis may be also suspected in the case of persistent erythema and pruritus after repeated resorcinol peels [1].

2.1.2. Toxicity

Systemic toxicity of resorcinol, due to percutaneous absorption [23], is extremely rare, but physicians must be aware of the potential risk. In fact, this event has been well documented following both industrial exposure and repeated skin applications [24].

Resorcinol has an antithyroid action similar to that of methyl thiouracil, although the two substances are not chemically related [25]. The interference with thyroid function seems to involve the binding of iodine and the release of thyroid hormones. Myxedema and hypothyroidism, occasionally associated with ochronosis, have been described, especially after prolonged applications on ulcerated areas [24,26,27]. The condition disappeared after resorcinol withdrawal.

Table 5
Possible cross-reactions with resorcinol

Meta-dihydroxybenzenes
Resorcinol monoacetate
Hexylresorcinol
Pyrocathecol
Hydroquinone
Hydroxyhydroquinone
Phenol
Pyrogallol
Orcinol
Resorcinol monobenzoate
Phenyl salicylate

Table 6
Salicylic acid ointment

Salicylic acid powder USP 50%
Methyl salicylate 16 drops
Aquaphor 112 g
Croton oil 1–2 drops (optional)

There have been reports of methaemoglobinaemia and acute poisoning, in some cases with fatal outcome, in children, even when limited areas were exposed to resorcinol [24,28–30].

Therefore, the application of resorcinol to ulcerative and other open lesions must be avoided in order to prevent massive absorption, and particular caution is necessary in children and subjects with a low body weight [3,24].

On the contrary, toxic effects have been rarely observed in adults. A syndrome characterized by pallor, cold sweating, dizziness, tremors, collapse and violet-black urine developed after daily use for 3–4 weeks of a 40% resorcinol paste [31,32]. Considering the potential for toxicity of resorcinol, the use of Jessner's solution has been restricted to limited surface areas, namely only to the face [33]. As resorcinol can produce marked vasodilatory effects, patients who undergo resorcinol peels may become light-headed and even syncopal. Therefore, they should lie down during the peel, and get up very slowly after treatment completion [2].

2.2. *Salicylic acid*

Salicylic acid (orto-hydroxy benzoic acid), widely used in dermatology as a keratolytic agent and an enhancer for percutaneous absorption of other substances, is another well-established peeling agent. Currently, Jessner's solution (Table 4) and the salicylic acid paste formula [34] shown in Table 6 are the most commonly used peels containing salicylic acid. Recently, Kligman has suggested the use of a peeling solution with 30% salicylic acid [35].

Table 7
Possible symptoms and signs of salicylism

Paleness	Headache	Slurred speech
Fatigue	Dizziness	Belligerence
Drowsiness	Tinnitus	Feeling of unreality
Hyperpnea	Hearing loss	Nuchal rigidity
Dyspnea	Dimness of vision	Convulsions
Nausea	Agitation	Circulatory collapse
Vomiting	Disorientation	Delirium
Thirst	Confusion	Psychosis
Anorexia	Lethargy	Stupor
Diarrhea	Retrograde amnesia	Coma
Hyperpyrexia	Delusions	Disturbances in
Profuse sweating	Depression	acid-base balance

2.2.1. *Allergenicity*

Salicylic acid may be responsible for contact urticaria [6]. Five cases of allergic contact dermatitis have been reported by Rudzki and Koslowska [36]. In none of these patients aspirin was able to evoke a systemic contact reaction. However, salicylic acid is a rare sensitizer [6], so patch testing is not required before peeling [2].

2.2.2. *Toxicity*

Systemic toxicity from salicylates, known as 'salicylism', is a well-defined condition. It may occur when plasmatic levels of salicylic acid are as low as 10 mg/100 ml, although severe symptoms usually do not appear at levels lower than 35 mg/100 ml. However, toxic levels are highly variable due to individual susceptibility. Clinical expression of salicylism includes gastrointestinal, respiratory, renal, metabolic, and neurological disturbances (Table 7). The early symptoms are usually represented by paleness, fatigue, drowsiness, and hyperpnea, followed by nausea, vomiting, hearing complaints, mental confusion and hallucinations. Breath abnormalities could culminate in Cheyne–Stokes respiration in the most severe cases. Modifications of respiration are extremely important as they contribute to relevant acid-base balance abnormalities. The salicylic radical generates hyperventilation through direct stimulation of the respiratory center in the medulla, resulting in respiratory alkalosis. Respiration can be also stimulated by the increased CO_2 production in peripheral tissues, especially in skeletal muscle. In a second stage, a metabolic compensated acidosis appears; finally, when the alkali reserve is depleted, decompensated acidosis can cause central respiratory depression, as well as circulatory collapse following vasomotor depression [24,37].

Prolonged use of salicylic acid over large areas, especially in children or patients with hepatic or renal disorders, can give rise to toxic effects, which can be also favoured by occlusive medications [38]. Several severe and fatal cases of intoxication due to the topical application of salicylic acid have been recorded, particularly in the older literature. These reactions developed mainly in children and, more rarely, in adults, in whom poisoning was frequently associated with the exposure of large areas to salicylate at high concentrations [24,39–42].

Apart from an immediate withdrawal of the source of intoxication, the management of salicylism depends on administration of fluids and oral/parenteral supplementation with sodium bicarbonate. Hemodialysis should be considered in severe cases when marked disturbances of acid-base balance or >1000 μg/ml salicylate concentrations persist.

Considering the concentrations of both resorcinol and salicylate in Jessner's solution, the risk of toxicity from this peel seems to be quite low. However, it has been repeatedly recommended that the solution be applied on limited surface areas to prevent massive absorption. In fact, signs of salicylism have been detected when Jessner's solution was applied simultaneously on several skin areas (face, chest, arms, and lower legs). Moreover, if a 40% salicylic acid paste is used, even smaller areas should be peeled [1,2]. Impaired renal excretion increases the risk of toxicity. In these cases, it is better to avoid salicylic acid or, at the most, to apply it to very limited cutaneous areas. Patients should drink not less than eight glasses of water during the first 12 h after the peel. After peeling, they should be instructed to notify immediately the physician if signs of intoxication take place. If patients develop light-headedness or tinnitus, they must remove bandages or any salicylic acid paste from their skin and increase their intake of oral fluids. Administration of intravenous fluids and urine alkalinization should be considered in severe cases [1,2].

2.3. *Phenol*

Phenol (carbolic acid), a toxic compound with antimicrobial properties, is sometimes used as an anti-

Table 8
Baker/Gordon phenol formula

Phenol USP 88% 3 ml
Tap or distilled water 2 ml
Septisol liquid soap 8 drops
Croton oil 3 drops

pruritic agent diluted at 0.5–2%. It is used in the well-known Baker/Gordon formula to prepare deep peels (Table 8), whereas the 88% phenol (full-strength) solution is a medium-depth peeling agent. However, because of its effects on melanocytes and melanin production, the phenol-based chemical peel is an important agent for the treatment of melasma. Therefore, temporary and permanent alterations in color remain the most significant limiting factors in deep phenol-based chemical peeling. In particular, hypopigmentation may occur, with a sort of post-peeling 'chemical leukoderma' [43].

2.3.1. Allergenicity

Topical phenol in very dilute solutions is irritant, particularly when applied in the diaper area or cutaneous folds. Reports of contact allergy to phenol are so rare that Fisher [6] considers it simply an irritant and a non-sensitizer. It can cross-react with resorcin, cresols, and hydroquinone. It may cause contact urticaria through a non-immunologic mechanism and necrosis of the skin and mucosae [24].

2.3.2. Toxicity

In animal models systemic absorption of phenol applied to the skin is rapid and extensive, with about 70% being absorbed within 30 min [44]. In rats, after oral, dermal, intratracheal, or intravenous exposure, phenol is also promptly eliminated in large amounts by the kidney (with a range of 75-95% within 72 h post-exposure) and is poorly retained in the body, where it is widely distributed with accumulation primarily in the liver, lungs, and kidneys [45]. The degree of absorption is most likely dependent on the extent of skin areas exposed than on the concentration applied [46]. After absorption, phenol is in part (25%) transformed into carbon dioxide and water, in part (75%) either detoxified in the liver through oxidation to hydroquinone and pyrocatechin, or excreted by the kidney in unchanged form or as phenyl sulphate and phenyl glucuronide [47].

In humans, application of 2% phenol in calamine solution or liquid paraffin results in blood levels of about 0.4 mg/dl, while as much as 25% of phenol is absorbed from application of 2 ml of a 0.25% aqueous solution left on the skin of the forearm for 60 min. The toxic dose for adults has been supposed to be 8–15 g [24]. Severe poisoning and even death have been associated with both oral and accidental skin exposure [48–51]. Oral ingestion of phenol has been found to induce fulminant central nervous system depression with subsequent hepatorenal failure and cardiorespiratory arrest [52]. Collapse, methemoglobinemia, abdominal pain, cyanosis, coma and dizziness are possible signs related to phenol poisoning [24]. In some cases, toxicity appears to be related to absorption by intact or wounded skin rather than by oral ingestion [4]. No hepato-renal or central nervous system disturbances from medical use have been described [3], whereas prolonged application of phenol medications to leg ulcers was responsible for ochronosis, sometimes associated with dark urine [53]. Industrial or accidental exposure of large skin surface areas to phenol caused hepatorenal toxicity. Anyway, no abnormalities of hemato-chemical, renal and hepatic function parameters were detected in 2000 patients peeled with phenol [54,55].

However, cardiac arrhythmias with occasional fatal outcome have been associated with phenol peeling [56–62]. In particular, Gross [59] referred that 30% of 54 phenol peel patients developed cardiac arrhythmias. Interestingly, Truppman and Ellenbery [57] observed arrhythmias in 23% of their patients when the peeling procedure was performed rapidly (namely less than 30 min) on 50% or more of the face; by contrast, no changes were detected when an equivalent surface area was gradually peeled over a 60-min period. The forms of arrhythmia recorded were: tachycardia (the most precocious form), premature ventricular contractions, bigeminy, paroxysmal atrial tachycardia, ventricular tachycardia, atrial fibrillation. A questionnaire-based inquiry carried out among 588 plastic surgeons revealed that 87% of patients did not complain of any cardiac disturbances [58].

Holter monitor electrocardiographic studies were done by Price [63] in 10 subjects before, during, and after Baker's phenol peels. The formula was applied

to six facial segments with intervals of 10–15 min between applications. Most patients developed more alterations in the preoperative phase than in the two following phases. Many spontaneous ectopic beats were noted, probably increased by anxiety and exercise; sedation and relaxation induced fewer ECG anomalies during and after peeling. The author assumed that ECG changes were associated with the chemical peeling in only one case.

The mechanism responsible for phenol cardiotoxicity is still unclear. Stagnone and Stagnone [64] hypothesized an idiosyncratic nature of fatalities associated with phenol use: in substance, the release of adrenalin resulting from intense facial pain could cause a heart arrest in predisposed individuals. Such effect might be due to vagal stimulation through the trigeminal nerve, leading to a cardiac hypodynamic status, or, alternatively, to stimulation of the sinoatrial node through the cerebral cortex, with consequent ventricular ectopic impulses able to induce ventricular fibrillation.

Also, phenol is probably directly cardiotoxic because in rats it causes myocardium depression with decrease in both rate and pressure, as well as slow electrical activity (with S-T segment depression and T-wave inversion) [65]. Cardiac arrhythmias and deaths were observed in 100% of the animals treated with Baker's phenol solution, but serum phenol levels were not related to the severity of symptoms, and fatal levels showed a wide variation. Therefore, only an ill-defined predisposition and an individual hyperreactivity to cardiotoxic effects of phenol might explain more severe responses. Gross [59] pointed out that in humans no correlation exists between serum phenol levels and arrhythmia. Neither sex, age, nor previous cardiac history were sufficient predictors of arrhythmia susceptibility. Before administrating a phenol peel, the presence of cardiac or hepatorenal diseases must be ruled out. For this purpose, a meticulous history and complete physical examination are necessary; an ECG, a complete blood cell count, hepatorenal profile, and electrolyte levels should be investigated. It is advisable that patients over age 40 also undergo a chest X-ray examination [1,66,67].

Taking into account that toxicity depends mostly on the cutaneous area exposed, the time of application of phenol peel, and the rate of renal excretion [43,44], it has been recommended that: (i) limited areas be treated for short periods of time; (ii) application of solution to other areas be adequately spaced in time; (iii) there be appropriate hydration and an increased excretion of alkaline urine [66].

Peeling must be performed in a medically supervised environment, where emergency cardiopulmonary resuscitation equipment is easily available; continuous monitoring of blood pressure, pulse and cardiac activity is required [66]. Patients have to be hydrated with 500 cc of lactated Ringer's solution before peeling and with another 1000 cc of fluid during and after the peel. The face is divided into five to eight units, and each segment should be peeled sequentially at 15-min intervals, allowing 60–120 min for the entire face [66,68]. Considering the above, sedation and analgesia are very important parts of the technique, not only to relieve the painful sensation caused by the peel, but also to avoid any potential cardiac response triggered by pain and anxiety. The use of fentanil combined with droperidol during the peel under local anesthesia has proven effective in reducing the impact of increased pulse rate and blood pressure [56]. Additionally, hypoglycemia and nausea can be prevented with 250–500 cc of dextrose in water [69]. If arrhythmias take place, phenol application should be ceased until a normal sinus rhythm has been restored for a suitable period of time (not less than 15 min). Then, the procedure may be cautiously continued applying smaller amounts of the formula on smaller facial segments. In the case of a major arrhythmia, the alternative use of trichloroacetic acid may be more prudent. The treatment of a persistent dysrhythmia includes intravenous lidocaine, bretylium tosylate, or cardioversion [1,4,63].

2.3.3. *Additional untoward effects*

2.3.3.1. Laryngeal edema Three patients developed laryngeal edema with stridor, hoarseness and tachypnea 24 h after a phenol peel [70]. Considering that the patients were heavy smokers, chronic irritation of the larynx could have promoted a sort of hypersensitivity response.

2.3.3.2. Toxic shock syndrome Toxic shock syndrome has been reported in three cases, after unoccluded (one case) and occluded Baker's phenol face peels [71,72]. *Staphylococcus aureus* was isolated from the face of

each patient and treatment consisted of beta-lactamase-resistant antibiotics and parenteral fluids. The reaction developed 2–3 days after the peel and was characterized by fever, hypotension, vomiting and diarrhea, followed by a scarlatiniform rash with subsequent desquamation. Other possible symptoms of the syndrome are mucosal hyperemia, myalgias, hepatorenal, hematologic, or central nervous system disturbances.

2.4. Other peeling agents

Other peeling compounds appear to be safe and non-toxic. In fact, to our knowledge, no systemic toxic reactions have been so far reported.

2.4.1. Carbon dioxide

Brody [1] described a case (out of 3000 subjects) of transient swelling and urticaria following use of solid carbon dioxide (alone or combined with trichloracetic acid). Although the ability of carbon dioxide to induce cold reactions seems to be very limited [1], caution is required in patients with a history of cold sensitivity.

2.4.2. Retinoic acid

It has been found that 7.8% of 245 patients treated with topical tretinoin had a mild elevation of transaminase levels, reversible with suspension of treatment [24]. The presence of erythema might promote the absorption of amounts of the retinoid sufficient to generate temporary interference with liver functions. Since no other studies have demonstrated changes in hepatic profile, the risk of hepatotoxicity from topical tretinoin appears to be negligible.

A few cases of allergic contact dermatitis from retinoic acid have been reported [73–80]. With regard to this, Serup [81] pointed out the difficulty of interpreting the reaction to a patch test with an irritant agent such as retinoic acid. Also, considering its widespread use, the author assumed that tretinoin is not (or only exceptionally) a sensitizer.

2.4.3. Pyruvic acid (PA)

PA is an alpha-keto acid, which converts to lactic acid. Its vapours, when inhaled, are pungent and irritating to the upper respiratory tract. An electric fan can be useful in these circumstances [1].

2.4.4. Trichloroacetic acid (TCA)

The safety of TCA, even at the concentration of 50%, has allowed the procedure to be unmonitored [64]. Stagnone et al. [65] demonstrated that TCA 50% was safer than phenol and not cardiotoxic in rats; only a modest decrease of blood pressure was observed, more relevant if TCA was applied to a particularly large area. Two rats treated with TCA died during the study: one due to uncontrolled surgical bleeding, the other from unknown causes (probably an idiosyncratic reaction to fear or pain, or anesthetic overdose). Therefore, neither death could be directly ascribed to TCA. These data are confirmed by the fact that there are no reports of TCA-related systemic toxicity or deaths [82]. At the same time, neither delayed nor immediate allergic reactions have been described. Rubin [2] reported a case of cholinergic urticaria after a 35% TCA peel, but this was probably triggered by tachycardia and vasodilation associated with the peel.

2.4.5. Alpha-hydroxy acids (AHA)

Similarly to TCA, these agents appear to be free of any sensitizing properties (1) because they have a stable molecular structure, which does not usually cause nucleophilic addition or other reactions involved in allergic contact dermatitis. Also, some AHA (lactic acid, glycolic acid) are physiologic components of biochemical reactions occurring in human cellular systems. Moreover, because of their stability, peeling solutions containing TCA or AHA do not require any additives or preservatives. However, a case of sensitization to lactic acid, contained in a wart removal solution, has been described [83]. Rubin [2] also reported two allergic reactions to lactic acid-based peels, but the list of all ingredients of the solution was not available. The author hypothesized that the sensitizer could be another chemical contained in the peeling solution rather than lactic acid itself. As previously emphasized with regard to retinoic acid, interpretation of patch tests with irritants is often problematic and requires special attention.

2.4.6. 5-Fluorouracil (FU)

FU has been shown to cause allergic contact dermatitis [84–86]. However, contact sensitization to FU was not confirmed by the Kligman maximization test [87]. On the bases of these findings, FU may be

at most a weak sensitizer [6]. Goette et al. [84] gave the following recommendations to distinguish an allergic from an irritant contact dermatitis to FU:

- development of a pruritic eczema at the site of application of FU ointment with a widespread itching dermatitis away from the treated area or a flare response at a site treated previously;
- development of a positive patch test with pure FU at concentrations of 5–10%;
- onset of indurated erythema with papules or vesicles at the site of intracutaneous injections;
- correlation between intracutaneous and epicutaneous responses;
- histopathology consistent with an eczematous reaction.

3. Conclusions

Although in use for a long time, peeling procedures have become more systematized only recently. In this context, safety parameters are also better defined. The use of peeling agents is not without any inherent risk; therefore, clinicians must acquire a complete and critical comprehension of potential risks in order to avoid or prevent them.

Systemic toxic effects may essentially derive from phenol peels and potentially from two phenol derivatives, resorcinol and salicylic acid. A complete understanding of the toxicological profile of peeling agents, along with correct execution of the technique and careful selection of subjects, can help avoid serious side effects.

Allergic contact reactions occur most frequently with the resorcinol peel, while most peeling agents are only rare sensitizers or appear to be free of true sensitizing power. Other types of hypersensitivity response appear to be very rare. Diagnosis of allergic reactions can be particularly difficult, as symptoms are similar to those produced by the peeling itself (erythema, edema, pruritus, burning or stinging sensation). Such reactions should be promptly recognized and treated as they can create the basis for slower healing and greater risk of local complications [2].

Post-peeling care is another important step. According to Brody [1], the occurrence of pruritus during the healing period can indicate a contact dermatitis to an ointment used in wound care, especially if accompanied by delayed healing, increased erythema or follicular pustules outside the peeled region. Finally, patients should be carefully cautioned against the use of potential contact sensitizers, such as neomycin [2], aloe vera and vitamin E [88], in the post-peel period.

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