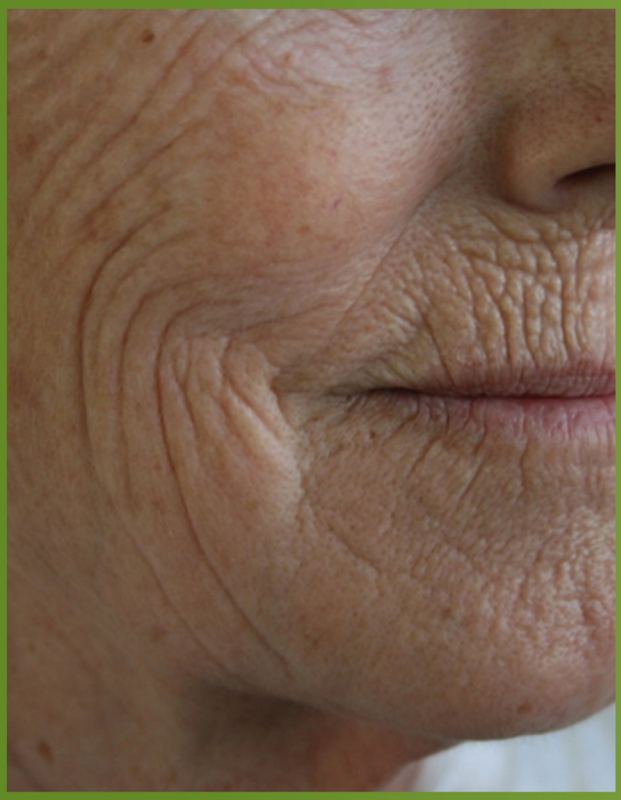
SERIES IN COSMETIC AND LASER THERAPY

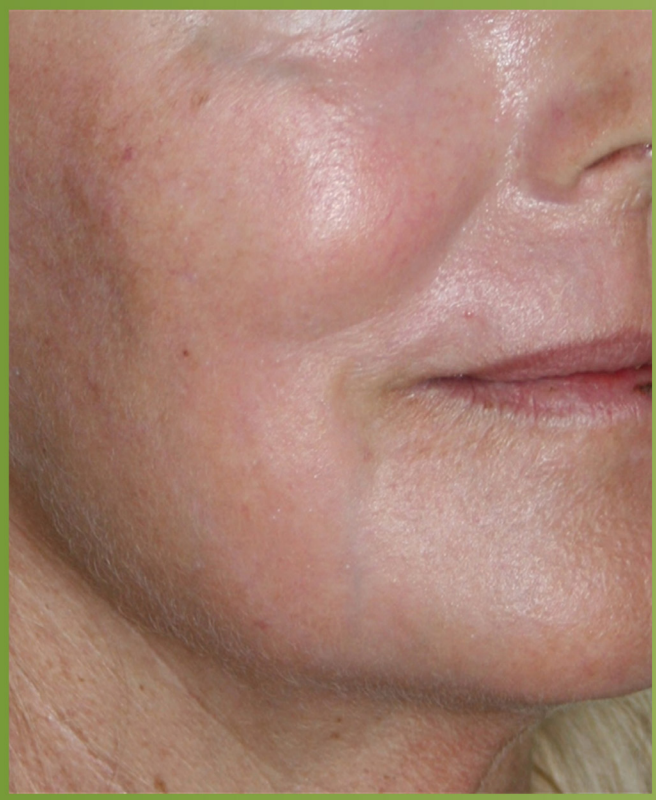
TEXTBOOK OF CHEMICAL PEELS

Superficial, Medium, and Deep Peels in Cosmetic Practice

SECOND EDITION

Philippe Deprez





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The publication of this work has been assisted by an educational grant from Skin Tech pharma group (www.skinstechpharmagroup.com and www.skintech.info).

It should be noted that this textbook is comprehensive about all available peel products but that there are many ancillary products (such as sunscreens) manufactured in comparable formulations about which it cannot be expected to be comprehensive; the author is most familiar with and recommends those from Skin Tech but does not imply by this that other products may not be comparable.

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Definition and classification of chemical peels

DEFINITION OF A CHEMICAL PEEL

A chemical peel is a skin treatment intended to visibly improve the structure of treated tissue by the external application of a caustic solution. It can simply accelerate the natural processes of exfoliation, but can also completely destroy the epidermis and a more or less large proportion of the dermis, essentially by protein coagulation or lysis. The effect of any peel reaches the dermis, directly or indirectly and to varying depths, where the processes of regeneration are induced to a greater or lesser degree, depending on the molecule or molecules used and the application procedure.

Chemical peels are among the oldest forms of skin rejuvenation and form a group of treatments in their own right. They are both flexible and effective, with a histological, chemical, toxicological, and clinical basis. They have an ancient history, have evolved rapidly, and can be adapted to almost any circumstances within the limits of their indications.

Most peels, to varying degrees, cause the same types of histological changes, whose clinical results lead to a more or less rejuvenating effect on all or part of the skin.

Classification is always restrictive, as it forces highly variable events into a rigid framework. So many different factors come into play that it becomes difficult to fit all chemical peels into a simplified and rigid classification of "superficial," "medium," and "deep."

Let us take the well-known glycolic acid peel as an example: its depth of action depends on the patient's skin type; the presence of associated disorders (e.g., seborrheic dermatitis); skin preparation in the long, medium, and short term; the type of presentation (gel, liquid, mask, or self-neutralizing pseudogel); the concentration of the product; the m/m (or w/w), m/v (or w/v), or m+v (or w+v) calculation, whether or not it is combined with other acid molecules (e.g., lactic or kojic); the pH of the solution (e.g., 0.5 or 3.5) and therefore the fraction of free glycolic acid; what it is applied with (brush, cotton pad, etc.); the number of coats; how forcefully it is applied; whether it is applied on the face or body; the exact location on the face (e.g., nostrils or eyelids[1]); the contact time; how or whether it is neutralized or diluted at the end of the peel; the immediate postpeel care; the quality of care between peels; the number and frequency of repeat sessions; and the list goes on.

It is clear that it does not take much to turn a very light glycolic acid peel into a medium-depth peel that can even reach the deeper layers of the dermis and risk discoloration or even scarring. All it takes is for the peel not to be neutralized properly. The same is true for all of these caustic molecules, which is why a thorough knowledge of chemical peels and skin anatomy is necessary before undertaking this kind of treatment. Every practitioner, through personal experience and practice, should aim to standardize his or her treatments to eliminate the maximum number of variables. Fortunately, new chemical peel formulas are easier, safer, and quicker to use, allowing young physicians to get on with the job of peeling without losing sleep or having postpeel nightmares. Sound knowledge and experience are still essential for peels to the papillary dermis.

CRITERIA FOR CLASSIFICATION

Molecular Dependence

It is very simple to understand that phenol is more aggressive than lactic acid but less simple to understand that a light trichloroacetic acid (TCA) peeling can give deeper results compared to deep phenol peel, when it is applied after a physical abrasion (see Combined peelings). Note that phenol peel should not be applied after abrasion for toxicological reasons.

Doctor Dependence

Classification may be personal; it may be related to the practice of one particular doctor who has standardized his methods of treatment with a view to limiting uncontrollable variables. But such a classification would not allow for any scientific exchange.

What would produce a superficial peel with one practitioner could in fact result in a medium peel with another who uses the same product with a different application technique. This is why peels are often considered to be doctor-dependent.

How can we give a valid classification for a treatment that is doctor-dependent? We should also compare products of the same type only, and yet the quality of the preparations and excipients is highly variable and impossible to control.

Chemical Dependence

TCA crystals, for example, are very hydrophilic, which means that they must be kept in perfect conditions so that the pharmacist can prepare the solutions we prescribe properly. How can we know how long the pharmacist's bottle of TCA crystals has been open? If the crystals have not been hydrated inadvertently (if the pharmacist closes the bottle immediately after taking out the required amount), the final concentration will be correct. If, on the other hand, the crystals are mostly hydrated (if the pharmacist leaves the bottle of TCA open while serving another customer), the concentration of the solution provided by the pharmacy will be abnormally low and not very effective. Peels therefore are also considered to be chemical-dependent.

Patient Dependence

Each patient has a skin type that is genotypically and phenotypically unique. The doctor must know each patient's skin history. Stable products that are properly prepared and applied with precise methodology, in the same way, by the same doctor, on the same day, can produce different results on different patients. Every morning, or maybe several times a day, patients go through their own particular skincare routine that the doctor doing the peel does not necessarily know about. For example, some teenagers secretly apply large quantities of topical benzoyl peroxide for acne. It reduces the thickness of the stratum corneum and makes the skin more permeable. This of

course makes it easier for the acids used for skin peeling to penetrate the skin and can, in some cases, cause unexpected burns. A similar situation arises with patients who want to present their doctors with perfectly clean skin and use abrasive creams. Their intention is noble, but the consequences are sometimes unpleasant. Therefore, a peel is also patient-dependent.

If we leave aside these variables, we can fit the different types of peels into their appropriate slots. This is just for the beauty of the exercise, however, as the variables still need to be taken into account. It is clearly possible to perform a superficial or medium peel using phenol. But, given the inherent toxicity of phenol, what would be the point? What is more, 70% unbuffered glycolic acid that is left for 10–15 minutes on a thin, sensitive skin that has been prepared with retinoic acid can result in a cosmetic disaster. It is possible to conduct good-quality, deep peels with TCA, but the risks can be greater than if phenol is used correctly.

PEELING CLASSIFICATION

Peelings are traditionally classified as superficial, medium, and deep peels. While these classifications seem simple and understandable, the literature gives us little comprehensive data about the different depths. What some authors consider as superficial is considered as medium by others, and what some consider medium others may consider as deep. A link with the concentration that is used is especially pointless, because, as described in Chapter 12, many details about the usable acid concentration interfere. The depth reached by a 25% TCA is different if the concentration is calculated in weight/weight (w/w), weight/volume (w/v), weight plus volume (w+v), or by dilution of a more concentrated solution prepared using one of these methods. Dramatic differences appear, generating side effects. Usually, acid concentrations are simply quoted in percentage, without specifying %w/w or w/v for example. In addition, the depth of action of an acid solution of x% will be different if one coat or several coats are applied, if the skin is thick or thin, if the skin is dry or oily, if the applicator is a brush or a gauze, if the pressure is soft or strong on the skin, and so forth.

The usual classification as superficial, medium, or deep is therefore obsolete.

In reality, it is better to determine the depth of a peel by clinically observing what is happening to the skin during the course of the treatment than by blindly applying preset recipes.

When we say, for example, that the result of a glycolic acid peel is time-dependent, this does not mean having to watch the clock but rather continuously analyzing how the skin is reacting to determine the best moment to start neutralization.

One basic principle must be respected: a peel should not be unnecessarily deep or unnecessarily superficial. There is no point in completely destroying the papillary dermis when treating a purely epidermal problem, and it is both pointless and ineffective to use an intraepidermal peel, even repeatedly, to treat a dermal problem.

Depths of Peelings

I usually consider seven depths of peelings (Figure 1.1).

Depth 1: Exfoliation (Very High Security)

The most superficial peel consists of a simple exfoliation of stratum corneum dead cells; it gives a good skin cleansing and a touch of better hydration. This "hydration touch" in reality results in skin damage: the peel removed the protective stratum corneum layer and the fingers are now directly in contact with superficial keratinocytes. Keratinocytes are living cells (only the most superficial layers are near to death) containing more water than stratum corneum cells.

Depth 2: Intraepidermal Peel (Very High Security)

The peel solution penetrates deeply into the epidermis, removing more cells; nevertheless, it does not touch any part of the

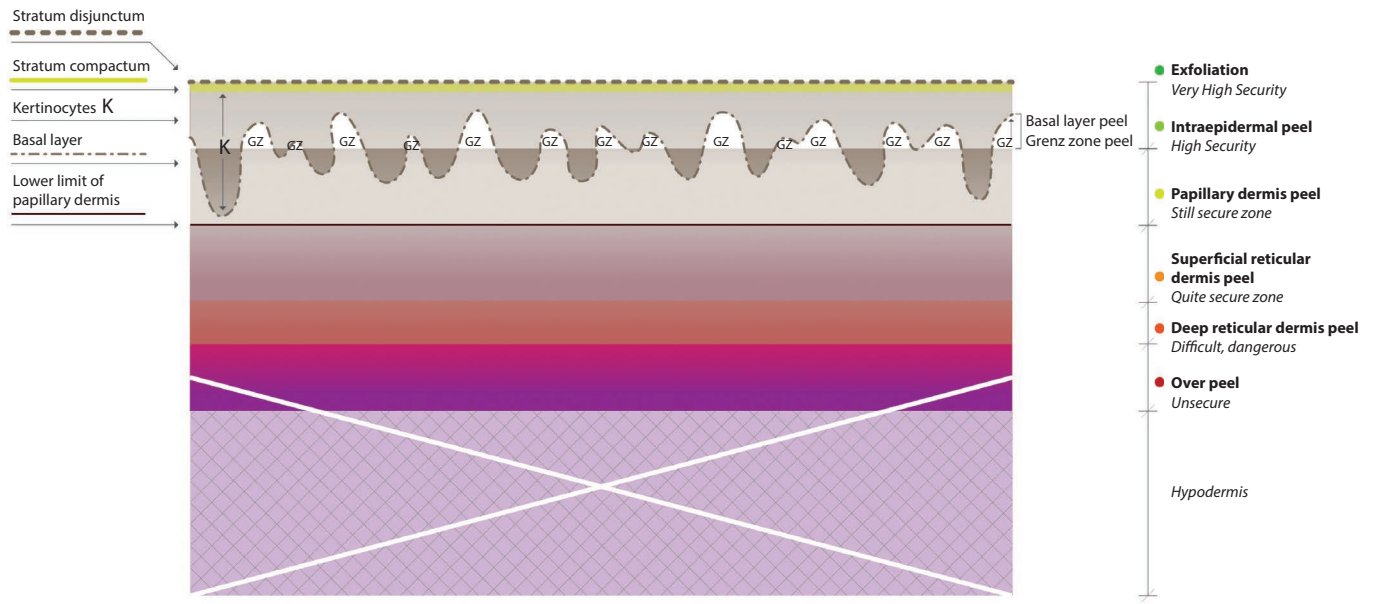

Figure 1.1 The seven possible depths of peel.

dermis or even the basal layer. The final touch of the skin is still more hydrated than in the case of a simple exfoliation, depth 1. After the peel, living keratinocytes are suddenly directly exposed to air, sun, pollution, and dryness. They react, synthesizing more tumor necrosis factor alpha (TNFa) (inducing a faster transformation of keratinocytes into corneocytes) and sending a message to the basal layer to stimulate the basal layer turnover and substitute the removed cells with new ones. At the same time another message reaches the fibroblasts, which respond with a stronger synthesis of the entire dermal intercellular matrix.

Intraepidermic peels (depth 2) give better results than depth 1 peels and can be used for treating superficial epidermal melasma and many keratinization problems.

Table 1.1 Exfoliation Level

Main types	Alpha hydroxy acid (AHA) peels are primarily used for exfoliation.
Action mode	The activity of AHA on the corneocytes seems to be secondary to an action on ionic charges, to the inhibition of enzymes involved in the formation of ionic links. For example, AHAs could compete with sulfates and phosphates at the level of sulfotransferases, phosphotransferases, or kinases, involved in the formation of sulfated or phosphorylated mucopolysaccharides, glycoproteins, sterols, and lipids. This could produce a lower quantity of electrically negative groups on the surface of keratinocytes and corneocytes and lower the adhesion forces with amines or basic aminated acids (electrically positive). AHAs penetrate between cells, unsticking the proteins responsible for corneo-desmosomes adhesivity (the adhesion is a noncovalent, electric link) and allowing the cells to separate from each other, inducing a desquamation. Because there is no strict chemical reaction during this process, AHAs are not consumed much and have to be neutralized. Rinsing with a basic solution stops their action.
Clinical signs	Irritative erythema is usually the only visible sign.
Desquamation	Typically, no desquamation is seen.
Risks and problems	In general, this is not a risky depth. The main risks are a higher sensitivity to the sun and a greater risk of skin infections. Neutralization is the main problem: if too early, it gives no result; if too late, it could induce more side effects. We will see later that this problem can be avoided by using specific slow-release and self-neutralizing AHA mixtures.

Table 1.2 Intraepidermic Peels

Main types	Alpha hydroxy acid (AHA), alpha-ketoacids, trichloracetic acid (TCA), resorcine, and salicylic acid peels can be used.
Action mode	TCA is a proteocoagulant chemical. When in contact with proteins, it coagulates them, modifying their tridimensional structures in a way that does not allow their normal function. All membrane proteins are therefore damaged, making the keratinocytes unable to survive. At the same time, intercellular proteins are also coagulated.
Clinical signs	Visible erythema can be seen, but no white pinpoints appear yet.
Desquamation	It can look like very thin dandruff.
Risks and problems	Intraepidermic peels are usually not dangerous. Nevertheless, cases of postinflammatory hyperpigmentations (PIH) have been seen, making the prevention of this side effect necessary when the skin is known to be sensitive. Neutralization of AHAs remains the main problem because it must be done following difficult rules. Neutralization has to be done when an erythema (always irregular erythema) appears and before any sign of protein coagulation that would appear as skin frosting points. It is difficult to foresee the right moment for an ideal neutralization. Regarding TCA, no neutralization can reverse the proteinic coagulation; therefore the total amount of TCA that is applied on the skin has to be perfectly calculated in relation to skin permeability. The TCA application technique has to be perfect for an even penetration. Resorcine and salicylic acid are phenol derivatives that are not widely used outside of the United States; large surfaces treatments using phenol derivatives are suspected to potentially induce toxic reactions. TCA and AHAs, on the other hand, are not toxic products.

Table 1.3 Basal Layer Peels

Main types	AHAs should not be used at this depth because side effects are likely here, are difficult to treat, and affect the patient's social life. TCA is the best choice for this depth if the right concentration, formula, and postpeel care are selected.
Action mode	Keratinocyte destruction induces a basal layer strong reaction, dramatically stimulating the turnover of basal cells.
Clinical signs	TCA coagulates proteins, and its entry through the domes of papillae induces a specific proteinic coagulation; dermal protein coagulation points occur, clinically appearing as little white marks (white pinpoints) called "frosting points."
Desquamation	It looks like a sunburn desquamation and does not affect the patient's social life in the majority of the cases.
Risks and problems	Basal layer peels are usually not dangerous peels. The application technique is important because a perfect protocol is very secure. If the peeling application is a bit too strong, basal layer peeling can nevertheless result in a vicious cycle of inflammation based on free radical liberation that induces cell damage and other problems. If we allow a self-stimulation of this inflammatory vicious cycle, melanocytes could react and cause postinflammatory hyperpigmentations (PIH). Cases of PIH have been seen, making the control of this postpeel inflammatory vicious cycle necessary. No herpes prevention is necessary. Problems primarily are linked to a melanocytary stimulation that is too strong without adequate treatment, to an irregular application, to an application that is too deep, or to infectious rebounds in case of acne. Prepeel skin conditioning can be used at this point if the peeling used does not penetrate evenly or does not control the postpeel inflammatory reaction. Using the Easy TCA® peel or Easy TCA® Pain Control, which is a stronger yet less painful form of Easy TCA®, no prepeel conditioning is necessary. Except in cases of deep scratching and/or strong local infection, no scar is expected from this peel depth.

Depth 3: Basal Layer Peel (High Security)

This is a very interesting peeling level because it is easily reached and gives good results. Stratum corneum cells are completely removed; keratinocytes are largely damaged up to the level of basal layer keratinocytes.

Nevertheless, the epidermis is not completely destroyed. Because many keratinocytes—less prone to damage by ultraviolet (UV) light—live in deep epidermal papillae, skin regeneration is fast and easy.

Basal layer peels can be used, as serial peelings, to treat aging skin (Glogau I–II), fine lines, epidermal melasma, keratoses, and acne (from black dots up to papule-pustule acne). Together with a good control of melanin synthesis (Blending Bleaching Cream), a TCA basal layer peel can treat many cases of melasma. If the patient's skin is adequately cleaned (black dots removed, microcysts opened, etc.) and if the patient applies disinfecting creams and creams limiting sebum production, then practitioners can treat active acne, usually without antibiotics.

Table 1.4 Grenz Zone Peels

Main types	TCA is a must for these depths. AHAs are not used because of their irregular penetration. It is difficult to use resorcine and salicylic acids to reach the Grenz zone. Phenol should be reserved for other indications.
Action mode	TCA coagulates keratinocyte proteins and dermal proteins, inducing a wider skin "frosting."
Clinical signs	No more pinpoints of frosting occur, but "frosting clouds" are seen, together with a diffuse erythema. Easy TCA® Pain Control reaches the frosting clouds more quickly than the classic Easy TCA® because it contains minute amounts of phenol.
Desquamation	Desquamation looks like a strong sunburn, which is easy for fair-skinned patients to live with. Dead skin becomes dark brown on darker phototypes.
Risks and problems	For dark phototype patients, social life can be difficult for a few days. At the same time, the risk of PIH becomes higher, making a "pigment synthesis sedation" quite interesting before and after this peel depth. PIH prevention is mandatory if the patient is phototype Fitzpatrick 4 or more or works outside in a sunny environment. Infections are uncommon at this depth because the immune system is still working. Herpes prevention is not required except in special cases of frequent recurrent herpes attacks. Other problems are the same as for basal layer peels.

Table 1.5 Papillary Dermis Peels

Main types	AHAs, salicylic acid, alpha-ketoacid, and resorcine are not good choices. Phenol has been used to perform depth 5 peels, but the related toxicity (cardiac, renal, hepatic) contradicts its use at this depth. A TCA peel, correctly applied, is the best choice for a safe and efficient papillary dermis peel.
Action mode	Same as the TCA action mode.
Clinical signs	After application, frosting clouds progressively or rapidly become pink-white uniform frosting that can progressively or rapidly turn into a pure white frosting. Why does this happen progressively or rapidly? Passing from clouds to even frosting is progressive when we use relatively low concentrations, as with Unideep (23% w/w) or Easy TCA® Pain Control. This concentration allows the practitioner to stop the application as soon as he or she sees the desired frosting begin to appear. An even, pure white frosting rapidly appears when using higher TCA concentrations, such as 35% or 40% (w/w). In this case, it is not possible to stop the TCA action. It can be compared to lighting the fuse of a firecracker; once lit, it is impossible to stop it or to modify the course of future events. Similarly, it is impossible to undo TCA by using neutralization. Frosting appears as pink-white, as long as the acids did not coagulate the blood vessel proteins. When acids have been strong enough for coagulating the well-defended perivascular area, blood cannot pass until the top of the dermal papillae, close to epidermis basal layer, and frosting tonality passes from pink-white to pure white. At the same time the acids penetrate the dermis, they coagulate proteins, sticking epidermis to dermis, and "epidermal sliding" appears. This sign will last for a while and disappear when dermal edema is strong enough for tensing the epidermis over it.
Desquamation	It looks like a snake changing its skin and lasts from 6 days (Unideep Peel, Skin Tech) to 8–12 days (usual TCA in water solution, pharmacy made). The patient usually can resume a normal social life the evening after the treatment but not the next morning. Days 2 to 6 are days of reclusion during which the skin will peel in more or less dark plaques, in relation to the patient's phototype.
Risks and problems	The most immediate risk is infection: viruses, bacteria, and mycoses find the skin totally open and without defenses. It is easy for them to penetrate and locally proliferate. It is therefore mandatory to prevent viral infections using herpes prevention (i.e., valacyclovir 3–4 days before and 4–5 days after the peel). Bacterial and mycotic infections can be avoided by proper hand and material cleaning and by avoiding any other source of iatrogenic infections. The patient must wash his hands before any contact with his skin (such as scratching), avoid direct contact with pets, and call the doctor immediately with question or concerns. Scratching the skin after a papillary dermis peel usually induces infection. Nontreated or poorly treated infections could induce PIH, depigmentation, or scarring. Another risk results from the fact that some peeling solutions do not evenly penetrate the skin. Simple TCA-in-water solutions irregularly penetrate the tissues and can give uneven results: some areas are too deeply treated (causing local erythema, pigmentations, depigmentations, infections, scarring, etc.). Because the real action of TCA is largely hidden during the application, damage can occur that the practitioner cannot see immediately and cannot correct. Therefore, the concentration of the peeling solution and, more important, the total amount of TCA applied to the skin must be strictly calculated before application. No neutralization of TCA is possible. When using a simple TCA-in-water solution, skin conditioning is mandatory for four main reasons: to allow a more even penetration, to allow a deeper penetration and hence a better result, to keep melanocytes in rest and limit the occurrence of PIH, and to stimulate the basal layer turnover and facilitate postpeel skin regeneration. Mixtures of AHAs, tretinoin, and hydroquinone are often used for this purpose.

Depth 4: Grenz Zone Peel (High Security)

This is a very interesting peel level. These peels are easy to perform, are not very painful for the patient, present a low level of risk, and offer good results. Stratum corneum and a large portion of keratinocytes are destroyed. Acids penetrate slightly into the more superficial layers of the papillary dermis, eliminating abnormal cells from the epidermis (treatment of lentigines, keratoses), and eliminating many keratinocytes excessively charged in melanin and melanocytes producing the melanine (melasma). A Grenz (German for "border area") zone peel also directly stimulates the superficial coats of the papillary dermis, allowing a strong collagen and elastin deposit into the Grenz zone. Grenz zone peels and basal layer peels are the types of peels I use most frequently.

Depth 5: Papillary Dermis Peeling (Secure)

A depth 5 peel is at the border between secure and insecure depths. This type of peel reaches some limits. It reaches positive limits in the sense that a depth 5 peel is able to treat many skin defects such as lentigines, solar keratoses, melasma, freckles, and fine lines. It reaches negative limits because a papillary dermis peel is not able to treat real wrinkles or skin sagging.

When strictly respected, this depth is safe from scarring; scars should never appear when a peel is strictly limited at the level of the papillary dermis.

Depths 6 and 7: Reticular Dermis Peeling (from "Quite Secure" to "Difficult/Dangerous")

A reticular dermis peel can be considered the Holy Grail of peeling: this depth of peel treats nearly all pigment problems, tenses the skin, and removes wrinkles. However, patients with thick and oily skin are not the best candidates for a reticular dermis peel because these skin types resist the action of the acids. Unfortunately, folds usually resist the action of deep peelings. Often, practitioners have to present patients with two therapeutic options: surgical lifting or deep peeling. At Hera Clinic in Empuriabrava, Spain, our first guide is a simple list of options (Table 1.6). Naturally, this list must be adapted to each

Table 1.6 Reticular Dermis Peels

Main types	Two main molecules are used for reaching this depth: TCA and phenol. I use concentrated TCA for focal deep peels and for deeply treating lentigines and keratoses with diameters less than 1 cm (Only Touch, for example, is a 45% w/w TCA), but I would not be keen to use it for large areas, such as a full-face peeling. In this case, phenol seems to be a better choice; its activity depth can be more easily kept under control and the results of phenol are definitively better, even at a similar depth as TCA. It seems that phenol has a stronger "rebuilding effect" on the skin than TCA. My favorite phenol peel is Lip & Eyelid Formula by Skin Tech. It is an oil of phenol that penetrates the skin slowly, which limits its general toxicity (giving the liver, the lungs, and the kidneys more time to detoxify it) and allows a longer contact time between phenol and skin proteins, inducing potentially more protein coagulation and hence a better result. A lighter form of the Lip & Eyelid Formula, a hybrid peeling between a TCA and a phenol peel, is the Easy Phen Light from Skin Tech. Both products are CE Class II certified.
Action mode	Phenol is proteolytic or proteocoagulant, depending on the concentration. Higher concentrations are proteocoagulant and lower concentrations are proteolytic. For peeling purposes, the best concentration range is between 40 and 60% (w/w). Nevertheless, many substances can interfere with its action and speed up or slow down its penetration. These substances are described in Chapters 25–36.
Clinical signs	Acids reach the reticular dermis after having largely coagulated the papillary dermis, showing a pink- or pure-white frosting. (Depending on the concentration, an aggressive peel will result in an immediate pure-white frosting, without first resulting in a pink-white one.) Quite quickly after the typical papillary dermis frosting, the tonality will shift to a gray-white or to a gray frosting. It is possible to reach this depth by applying various acid concentrations. However, I always feel more secure using less concentrated products and applying more coats. When we use proteocoagulant products, the final result depends on the total amount of active acid molecules that have been able to interact with the skin proteins. A very strong and aggressive peeling solution could induce a superficial thick coagulation, allowing the acids to pass only at the level of higher skin permeability, which could induce irregular results and local overpeelings. When using a progressive application technique, we can always decide to apply no more acid to the higher permeability areas and to keep applying acid to the areas where the desired frosting did not appear. Using this method, I have performed no overpeels during the last 30 years.
Desquamation	Desquamation is a major issue that can force a patient into social retirement for 7–8 days. Dead skin layers should be kept as natural protection and extracted only at around day 6 or 7, if this extraction is easy and atraumatic. A phenol peel can be used under a complete 24-hour occlusion, inducing a maceration of the upper coats of the skin. During occlusion, skin melts (in open techniques, skin usually dries) and has to be protected by using bismuth subgallate powder. On day 5 or 6, sterile petroleum jelly can be applied to the dead skin to help the desquamation. Occlusion makes the phenol peel deeper and more efficient. TCA occlusion does not have the same result.
Risks and problems	Histologically, there is only one reticular dermis, situated between the papillary dermis and subcutaneous tissues. However, with regard to peelings, we face two different depths. In the more superficial reticular dermis, overall at the face level, we still can find keratinocytes (mainly at the level of hair roots and sebaceous glands; sebocytes are phenotypically differentiated keratinocytes, able to undifferentiate into normal keratinocytes when necessary to repair the skin). The superficial reticular dermis still has material to rebuild the skin. The deep reticular dermis is devoid of this reservoir but contains large fibroblasts, also differentiated to be able to synthesize a thick bundle of collagen that will stick to the neighboring fibroblast. The fibroblasts are considered contractile nonmuscular cells, able to contract when necessary. They are one of the main groups of cells responsible for the scarring process: when these cells are strongly stimulated during a self-maintained inflammatory vicious circle, scarring can appear. All possible side effects can appear when using deep peelings. Pigment problems are common because deep TCA kills melanocytes and phenol can make them impotent, which makes them unable to synthesize melanin. As a result, many cases of unaesthetic depigmentation were seen in the past. A new formulation (Lip & Eyelid Formula from Skin Tech) seems to be much safer in this regard because it primarily induces postinflammatory hyperpigmentations (PIHs) that are easy to treat rather than "porcelain skin" that cannot be treated. Chapters 25–36 give details of many of the possible side effects.