Paparella IV: Section 1: Plastic and Reconstructive Surgery

Chapter 10: Dermabrasion and Chemical Peel

Kevin A. Shumrick, Ajay K. Mangal, Russel W. H. Kridel

Dermabrasion

The term dermabrasion refers to the mechanical abrasion, in successive layers, of epidermis and upper dermis. The process of dermaplaning, on the other hand, employs a dermatome to remove a layer of split-thickness skin. In either case, the unaffected epidermal lining of the deeper adnexal structures regenerates the surface epithelium to form a smoother, more aesthetically pleasing skin surface.

Dermabrasion is an ancient concept. The Egyptians used a combination of alabaster and pumice as a skin abrasive to remove blemishes and smooth the skin. However, the modern use of dermabrasion is credited to Kromayer of Germany who in 1905 introduced motor-driven circular knives to abrade various depths of skin. Later he developed rotating burs with dental drills to perform his "scarless surgery", using ethyl chloride spray as the topical anesthetic. He also noted that leaving the reticular dermis untouched was the key to scarless epithelial regeneration.

Janson (1935) described the use of a rotating wirebrush, and Iverson (1947) reported using sandpaper to remove traumatic tattoos from the face, which gave further impetus to the procedure. McEvitt (1950) published a report on the effectiveness of sandpapering acne scars. Kurtin (1953) further popularized the procedure by introducing the first motor-driven wirebrush and is given credit for the term "skin planing". Kurtin used ethyl chloride as a topical anesthetic as well as a hemostatic agent. Wilson and colleagues (1955) substituted Freon 114 (dichlorotetrafluoroethane) for ethyl chloride. DaSilva (1962) introduced a miniature dermatome with suction attachment. Malherbe and Davies (1971) introduced the narrow Davies electric dermatome for central planing and a lateral motor-driven sandpaper cylinder to level the peripheral edges of the planed area.

By the late 1950s dermabrasion had gained significant popularity, and inexperienced practitioners began using the technique inappropriately. Consequently, there was increasing dissatisfaction with dermabrasion on the part of both physicians and patients, and reports of severe complications began appearing; thus, the use of this technique declined in the 1960s. However, it is now recognized that when used appropriately, dermabrasion can bring about dramatic improvement in skin contour and texture, and it is generally considered a valuable tool in the armamentarium of the facial plastic surgeon.

Histopathology

The skin basically consists of the epidermis, the dermis, and subcutaneous tissue. The epidermis is composed of five layers: stratum corneum, stratum lucidum, stratum granulosum, stratum spinosum, and stratum germinativum. The dermis is divided into two layers: the more superficial papillary layer and the deeper reticular layer. It is crucial to distinguish between the papillary and reticular layers because the entire epidermis and papillary layer of the

dermis may be removed with complete reepithelialization and no significant scarring. However, the deeper one extends into the reticular dermis, the more likely one is to encounter significant scarring.

Removal of the upper layer of skin by any one of a variety of methods (thermal injury, mechanical abrasion, chemical peeling, or removal of a split-thickness skin graft) results in very similar histopathology upon healing. Initially, a coagulum forms from the accumulation of neutrophils, lymphocytes, serum, blood, and cellular debris. This crust seals off the dermabraded area and is a significant barrier to infection. At 48 hours the crust consists mainly of necrotic cellular debris and fibroblasts and capillary proliferation at the level of the dermal surface. Reepithelialization of the denuded surface occurs from a combination of epithelium growing from the wound margins and extension from the outer root sheaths of the hair follicles. Generally, by the fifth to seventh day, complete epidermal regeneration takes place and the crusting spontaneously separates. This newly regenerated epidermis initially is loosely attached to the dermis, and one must be careful in removing dressings not to inadvertently remove the new skin. Other areas of the body may take a significantly longer time for reepithelialization to occur than the face.

By 2 weeks the epidermis is well attached and the dermis is regenerating. This dermal regeneration takes the form of a mild proliferation of fibroblasts, a significant increase in collagen, and increased capillaries. The new fibroblasts line up parallel to the skin surface, and the new collagen fibrils are arranged in parallel bundles, as opposed to the randomly arranged bundles seen in nontreated skin. Luikart and associates (1959) noted that this horizontal collagen persists for at least 4 years. They also considered this new collagen and the increase in fibroblasts to be the key to the smoothness and enhanced contour of the newly reepithelialized surface. Increased collagen crosslinking and fibroblast contraction are thought to contribute to the smoothness and tautness of the new surface. The new skin surface appears smooth, firm, pink, hypopigmented, and less wrinkled after dermabrasion.

The hypopigmentation seen following dermabrasion is due to the removal of the melanin-containing melanocytes and keratinocytes, which are primarily located at the epidermal-dermal junction. The pink color, which is due to the increased number of capillaries, is initially very apparent but generally lessens by 10 days to 3 weeks; however, it may persist for up to 6 months as a result of continuing changes of the fibroblasts, collagen, and pigment. Because of these ongoing modifications, patients may not fully appreciate the benefit of dermabrasion for 3 to 4 weeks postoperatively, and changes continue for up to 6 months. The pinkness and hypopigmentation generally resolve over 1 to 4 months, but it is possible that the dermabraded areas will never fully match surrounding untreated skin. Also, during this time while the skin is being repigmented, it is quite sensitive to ultraviolet radiation and may be easily burned. There is the additional possibility of actual hyperpigmentation with sun exposure, and sun screens are mandatory for 4 to 6 weeks after dermabrasion.

Indications

The major indications for dermabrasion are a need for improvement in skin contour by smoothing areas with irregular surfaces, the desire for blending of various types of facial scars, and a need for removal of various lesions related to actinic damage. As such, the major

indications have consisted of acne scars, post-traumatic scars, and actinic and seborrheic keratosis. Dermabrasion also improves rhytids but these are probably best handled by a chemical peel, which has also been used with varying success for many other lesions (Table 1).

Table 1. Indications for Dermabrasion

Major	Minor
Cicatrix	Overlay grafts
In acne	Deepithelialization of flaps
In chickenpox	Thinning of cartilage
In smallpox	Common freckling
Traumatic	Epithelial nevi
Rhytides and rhagades	Adenoma sebaceum
Tattoos	Syringoma
Actinic keratosis	Melasma
Seborrheic keratosis	Telangiectasia
Rhinophyma	Miscellaneous.

Acne vulgaris is a low-grade chronic infection in the pilosebaceous units of the skin with coincident microabscesses. Upon healing these lesions leave pits of variable depth throughout the skin. The amount of scarring varies from mild irregularities to massive distortion of facial skin form and texture. Unfortunately, this occurs at a time in patients' lives when appearance is of major concern, and the residual acne scars may lead to intense psychological preoccupation. In the past, acne scars were treated with diverse methods including incision and drainage, electrodesiccation, cryotherapy, and chemical peel, all of which met with generally unsatisfactory results. Dermabrasion is especially helpful for discrete, well-defined, nonconfluent, shallow acne scars. To obtain the best possible results, the entire pit with all its walls and floor must be abraded. If the floor is left untouched, the improvement may be only temporary. The deep and narrow "ice-pick scars" that extend through the full thickness of dermis are generally not improved by dermabrasion, and the scarring may actually be worsened. Punch grafting may be helpful in these cases. Multiple dermabrasions may be performed with improved results, but there should be an interval of 3 months between each dermabrasion.

Owing to its marsupializing action on infected pilosebaceous units, dermabrasion may also be helpful for active acne. However, with new treatments such as 13-cis-retinoic acid (Accutane), most surgeons elect to wait until the active infection subsides. There are mixed reports in the literature with regard to possible adverse effects from the use of retinoids perioperatively with dermabrasion. Mandy published his experience with 123 patients, 88 of whom received 0.05 percent tretinoin cream and 35 of whom received no pretreatment. The patients receiving retinoid cream healed faster and with fewer postoperative complications, such as milia and hyperpigmentation, than the nontreated group. However, Rubenstein and colleagues (1986), reported that all of their six patients who underwent dermabrasion while on Accutane, or having recently completed such therapy, developed keloids. Retinoids are known to suppress collagenase and predispose patients to keloid formation; thus, oral retinoids are probably best avoided if dermabrasion is being considered.

For chickenpox and smallpox scars, dermabrasion can be used alone or in combination with punch-grafting techniques. It is of less benefit when the scars are deep and confluent.

Scars of any etiology should become less noticeable through dermabrasion as a result of a decreased difference between the level of the cicatrix and that of the normal skin. This improvement in levels is brought about by the simultaneous process of removing prominent points and raising depressions through the augmenting effect of native collagen production. Linear scars that are not depressed are also improved by blending them with the surrounding tissue. Second-degree burn scars are also benefited by dermabrasion, and skin grafts that are hyperpigmented can be depigmented with dermabrasion. Most traumatic scars are dermabraded 4 to 6 months after the injury, when they have matured, but several authors have advocated light dermabrasion at 4 to 6 weeks after injury to improve the final scar appearance. Debris tattooing from foreign bodies impregnated into open wounds is difficult to treat by any method once the wound has healed; dermabrasion may be used acutely on the open wound to facilitate debris removal and supplement conventional scrubbing techniques. Dermabrasion is effective in removing debris in the superficial dermis, but is ineffective for deeply imbedded debris.

Dermabrasion is the treatment of choice for early rhinophyma. However, for advanced lesions a debulking procedure should be performed first and dermabrasion then utilized for fine contouring. Dermabrasion may also be used to deepithelialize a skin graft or to thin down cartilage as an adjunctive step in rhinoplasty or otoplasty procedures.

Fine and medium facial wrinkles around lips, cheeks, nasolabial crease, eyelids, and brows can also be improved with dermabrasion. Farrior prefers dermabrasion to a chemical peel for fine wrinkles because he considers the former makes it easier to control the depth of abrasion; in his experience, dermabrasion gives as long-lasting results as a chemical peel.

Wide superficial dermabrasion can be used for common freckling, but if the dermabraded area is exposed to sun, freckling may return.

Dermabrasion has been successfully used for senile keratosis, seborrheic keratosis, superficial basal cell epitheliomas, and Bowen's disease.

When tattoos are superficial and do not penetrate the deeper reticular dermis, they can be successfully dermabraded. However, most professionally made tattoos penetrate the deep reticular dermis or even into the subcutaneous layer. Dermabrasion is not effective for this kind of tattoo and may actually make it more prominent by removing pigment-containing cells in the surrounding epidermis and rendering the skin around the tattoo hypopigmented.

Dermabrasion can be performed in black patients but requires great care. The experience of Orentreich and Dunn with blacks has been of consistent hypopigmentation for the first 6 weeks with gradual return of pigmentation; no increase in hypertrophic scarring or keloid formation was found. In Asians and Orientals it is even more difficult to predict the final outcome from dermabrasion, and there may be problems with both hypo- and hyperpigmentation; dermabrasion in these individuals should be approached with caution.

Contraindications (Table 2)

Since the success of dermabrasion is primarily dependent on the skin's ability to regenerate a new epithelial layer from deep dermal adnexal structures, dermabrasion should not be carried out where pilosebaceous units are absent. Certain areas of the skin are primarily deficient of pilosebaceous units, such as the eyelids, low neck, and medial aspect of the arms; the risk of scarring is greater in these areas. It is for this reason that Spira (1977) suggested using chemical peel and dermabrasion together in patients with scarring and rhytids: chemical peel for thin, wrinkled, unscarred skin and dermabrasion for the thicker scarred areas. Areas secondarily deficient of pilosebaceous units include third-degree burn scars, sites of chronic radiation dermatitis, and skin with keloids.

Table 2. Contraindications to Dermabrasion

Absolute	**Relative**
Bleeding disorders	History of herpes simplex
History of keloids	History of hypertrophic scar
Chronic radiodermatitis	Psychiatric disorder
Pyoderma	Vitiligo
Malignancy	Medications: diazepam (Valium), phenytoin (Dilantin), birth control pills.

Dermabrasion also is clearly contraindicated in patients with bleeding disorders, and generally has no place in treating vascular lesions such as cutaneous hemangiomas. Furthermore, dermabrasion should not be employed where malignancy may be a consideration.

Patients with a history of vitiligo can develop persistent hypopigmentation in an abraded area and thus usually are not suitable candidates.

Patients who have had previous attacks of herpes simplex are at risk for a recurrence after dermabrasion. This may arise even if the previous lesions have been confined to the lips, and may progress over the entire dermabraded area. Patients with a history of herpetic lesions should be treated prophylactically with oral acyclovir.

Patient Selection

An ideal candidate for dermabrasion is a fair-skinned individual, with superficial lesions over an area of thick skin, who is well aware of the procedure, with its risks and possible complications, and who has realistic expectations. The lesion should be severe enough to warrant such an undertaking. Ideally, the patient should not be on any medications that interfere with pigmentation, such as estrogens, birth control pills, or phenytoin (Dilantin). Also, medications with primary effects at the skin level, such as Accutane and Rein-A (both retinoic acid), should be discontinued for at least 3 months before dermabrasion.

Equipment

There are two basic components necessary for dermabrasion; a power unit to drive the abrading surface and the actual surfaces used for abrasion. Many types of power unit are available, varying considerably in sophistication and convenience. The earlier models were air or cable driven, and somewhat clumsy and bulky. Since then, power units have been considerably refined, the newer ones being electronically driven, noiseless, vibration free, and capable of speeds varying from 600 to 18.00 rpm in either direction. The ability to reverse the direction of rotation is a convenient feature since it allows one to direct debris and spray generated during the procedure away from the operator. One unit that incorporates these features is the Bell hand engine, which is lightweight, portable, and electrically driven; has variable speed and direction; and attaches to a convenient handheld power unit.

One of the earliest abrading surfaces was simple carpentry sandpaper. This was replaced by a number of wirebrushes of variable widths and coarseness. The abrasion that is caused by the exposed tips of wirebrushes actually creates multiple microlacerations as the skin surface is abraded. Wirebrushes, although effective in planing down cutaneous surfaces, have significant potential for creating inadvertent full-thickness defects, and have been largely replaced by diamond fraises, particularly in the hands of inexperienced operators. These come in a variety of shapes and degrees of coarseness and act as true abraders of the skin, as opposed to the wirebrushes, which actually produce multiple small cuts. Many operators consider that the diamond fraise allows easier control of the depth of abrasion, and lessens the risk of inadvertent full-thickness extensions or injury of surrounding structures. Alt is a strong proponent of the diamond fraise for dermabrasions and cites a long list of advantages. The fraise is less likely to catch or gram the skin with an inadvertent gouge and can be used on semi- or nonfrozen skin. This is in contradistinction to the wirebrush, which requires firmly frozen skin to prevent gouging. Alt believes that the skin should still be frozen as firmly as possible for dermabrasion with a diamond fraise, but others consider it just as effective on unfrozen skin. This is an advantage when the skin needs to be only slightly frozen for limited dermabrasion, or if it is desired to avoid freezing altogether in order to prevent the possible sequelae of multiple freezing episodes. Another advantage of the diamond fraise is that it may be rotated clockwise and counterclockwise, unlike the wirebrush, which, owing to the angle of the ends, cannot be effectively rotated both clockwise and counterclockwise without losing a considerable degree of abrasiveness. Alt feels that, since the diamond fraise has a flatter surface than the wirebrush, the dermabraded skin will be significantly smoother than the same skin dermabraded with a wirebrush. There are significant limitations in regard to the choice of wirebrushes available, but diamond fraises come in a wide variety of grit coarseness as well as various shapes, ranging from standard cylindrical fraises to pear-shaped configurations. These allow much easier dermabrading of contoured surfaces such as the nasolabial crease or the area around the lips.

Preoperative Preparation

It is of paramount importance that pre- and postoperative photographs be obtained for appropriate documentation and comparison. Surface irregularities can be enhanced by using a single light source placed at a tangent to the skin surface. With this technique, high points are well lighted and shallow points remain dark. If photographs are obtained using a light source placed in a perpendicular fashion or a ring flash, the irregularities become much less

apparent. For adequate comparison, postoperative photographs should be obtained with comparable lighting and positioning. A lens with a 90- to 105-mm focal length should be used to avoid the distortion seen with a 55-mm lens.

The face should be well cleansed preoperatively with a mild germicidal soap, such as pHisoHex; women should wear no makeup and men should be clean shaven. Hair should be secured out of the field so as not to get caught in the dermabrader. We prefer to administer intravenous antibiotics such as a cephalosporin approximately one-half hour before dermabrasion is performed; in addition, dexamethasone (Decadron), 10 to 12 mg, is administered intravenously. Some surgeons prefer to paint the entire face with gentian violet to make sure that all areas are dermabraded, but we consider this to be unnecessary and messy. The gentian violet also may be misleading if it goes into the depths of ice-pick scars that are full thickness and an attempt is made to remove all the residual dye. However, it is recommended that the general areas to be dermabraded be outlined, as it may be difficult to distinguish between various boundaries once the skin refrigerants have been applied. Areas of particular concern should also be outlined with additional light marking. Areas usually requiring additional attention include the danger sites overlying bony prominences such as the malar ridge, the zygoma, the bossing of the chin, and the frontal bossing of the forehead in the glabellar region. It is also recommended that the mandibular ramus be marked out, since the dermabrasion should be extended somewhat inferiorly so that any lines of demarcation between dermabraded and nondermabraded skin are hidden in the shadow cast by the mandible. Generally, the lower limit of dermabrasion is approximately 1 cm below the mandibular margin.

In this day of blood-borne illnesses such as hepatitis and AIDS, it is mandatory that some eye protection be worn during dermabrasion. The minimal requirement is eye goggles and, preferably, face shields for both operator and assistants. In view of the considerable spray generated during dermabrasion, serious thought is needed before performing an elective dermabrasion on a patient known to have AIDS or hepatitis. Many operators consider this a distinct contraindication to dermabrasion.

Preoperative sedation is advantageous to both patient and operator. It allows for a much more relaxed patient who will remember the experience in a more favorable light, and also reduces the amount of anesthesia required. We prefer orally administered diazepam (Valium), 15 mg, and dimenhydrinate (Dramamine), 200 mg, approximately 1 hour before the procedure. Once the procedure begins, we generally supplement this with 2-mg incremental doses of midazolam (Versed) and 12- to 25-mg doses of meperidine (Demerol). However, this is strictly a personal preference and there are a variety of other regimens using morphine, methohexital (Brevital), thiopental (Pentothal), hydromorphone (Dilaudid), and even general anesthesia. It goes without saying that if one is using intravenous medication with the potential for respiratory depression, the patient should be fully tested with electrocardiography (ECG), blood pressure monitoring, and pulse oximeters. When possible, it is advantageous to perform regional nerve blocks to provide additional anesthesia both during the procedure and postoperatively. To this end, we use a solution of 1 percent lidocaine (Xylocaine) with 1:100.000 epinephrine mixed in a ratio of 1 to 1 with 0.5 percent bupivacaine (Marcaine). This provides analgesia during the procedure and postoperatively. The nerves that generally are blocked are the supraorbital, supratrochlear, infraorbital, submental, and occasionally zygomaticotemporal. If a small area of the face is to be dermabraded, a subcutaneous

infiltration of this mixture provides adequate anesthesia.

Topical refrigerants have long been used in dermabrasion to provide a topical anesthetic effect and freeze the skin into a semisolid state for more effective dermabrasion. Alt feels that the importance of using topical refrigerants lies in making the skin into a firm-solid surface that allows more effective dermabrasion, just as it is easier to file a piece of wood rather than a piece of gelatin. That is, soft or unfrozen skin may become distorted with application of the dermabrading surface. This distortion allows the head of the dermabrader to sink below the level of the surrounding skin, which may give rise to uneven dermabrading and even increase the chances of a grabbing or avulsion type of injury. If the skin has been adequately frozen, it will resist this distortion with avoidance of "walking" or ricochet-type injuries. Adequately frozen skin is absolutely essential for dermabrasion with wirebrushes, but there is some room for variation with diamond fraises. Freezing also provides some degree of hemostasis, at least temporarily.

Some authors have contested whether skin freezing is necessary to obtain good results, and believe the skin refrigerant actually promotes additional tissue damage and prolongs skin healing. Four commonly used spray refrigerants are available to induce freezing of the skin. They are all based around several different Freon compounds, and their temperatures are directly related to the various components contained within them. Frigiderm is based on Freon 114 and generates skin temperatures of approximately -28°C. Fluro-Ethyl is a combination of Freon 114 (75 percent) and ethyl chloride (25 percent) and generates a skin temperature of -30°C to -35°C. Cryosthesia -30°C is a combination of Freon 11 and Freon 12, and Cryosthesia -60°C is pure Freon 12; both of these compounds generate significantly more freezing than either Frigiderm or Fluro-Ethyl. Hanke and O'Brian compared Frigiderm and Fluro-Ethyl with the Cryosthesia compounds and believe that there is significantly greater skin damage with the colder temperatures induced by the Cryosthesia materials. They noted no microscopic changes in guinea pig skin after a 45-second freeze with the Freon 114-based compounds. However, there was significant necrosis and skin damage with the Cryosthesia compounds after a 45-second freeze. They also noted that after short freezing periods the skin could be refrozen with no additional injury using the Freon 114-based compounds, whereas refreezing with the Cryoesthesia compounds added further injury.

A histologic study by Dzubow (1985) using guinea pigs to study the effects of spray refrigerants concluded that significant epidermal and dermal injury resulted from the use of spray refrigerants. Dzubow felt that the severity of the injury was a function of spray duration and freeze intensity, and noted that the margin of safety with the Cryosthesia preparations was less than with Frigiderm or Fluro-Ethyl. He also observed that refreezing after the initial dermabrasion caused added injury and adversely affected healing.

Dzubow proposed that (1) spray refrigeration is not without risk, (2) the freeze time and depth should be limited to just that amount required to produce topical anesthesia and skin rigidity, and (3) overlap freezing and refreezing may create additional tissue injury and should be kept to a minimum.

For skin freezing, some authors have reported beneficial effects from prechilling the skin as much as possible. The prechilling takes the form of providing a cool operating room with air conditioning as necessary to provide an ambient room temperature of at most 72°F

and preferably in the middle to low 60s. This is coupled with skin prechilling with commercially available multipurpose cold packs, which are placed in the refrigerator and allowed to reach a temperature of 0°F. The packs are placed on the side that will be dermabraded first and allowed to remain in position for approximately 15 minutes. Once surgery has begun, the packs are moved to the next site to be dermabraded so that it may be cooling while surgery on the first side is being completed. In this way the skin will not have time to warm up, as it would if the entire face was prechilled before the procedure and then all cooling material removed before the start of surgery. Alt believes that a properly cooled operating room and the addition of precooling packs allow a significant decrease in the amount of skin refrigerant required and provide for longer freezing with the amount of refrigerant used.

Surgical Technique

The specific order in which sites are treated is not particularly important. When segmental dermabrasion is to be performed, it is extremely important that full aesthetic units (lips, cheeks, nose, and so forth) be treated to minimize lines of demarcation. Spot dermabrasion, except in very small discrete areas, is generally condemned as providing suboptimal results. Whether frozen or not, the skin should be kept under firm tension by the operator and an assistant. The dermabrader should be grasped with four fingers around the shank and the thumb extending along the shank. This position facilitates movement of the dermabrader parallel to the skin surface and minimizes the possibility of an inadvertent gouge. When the wirebrush is used, it is important that the direction of the stroke of the dermabrader be perpendicular to the plane of rotation of the brush. With the diamond fraise it is not necessary to dermabrade perpendicular to the rotation of the fraise, and it can be moved in a 360-degree circle as required by the anatomy or surgical setup. The depth of dermabrasion is determined by the appearance of the underlying tissue, and accurate judgment of the depth of dermabrasion requires considerable experience with this procedure. The appearance of white, parallel collagen fibers within the operative field denotes that the papillary dermis has been entered. When intermittent fraying of these fibers is noted, the level is in the reticular dermis. When most of the collagen fibers are frayed, the full thickness of dermis is about to be penetrated and the subcutaneous tissue entered. In general, one should not dermabrade deeper than the midreticular dermis and, ideally, should aim for the deep papillary dermis to minimize scarring.

As mentioned, the face is dermabraded segmentally, generally starting with the most dependent portions of the area to be dermabraded to avoid blood running into the field. A topical refrigerant is held approximately 4 to 6 inches from the face and applied just long enough to achieve a hard freeze of the skin. Care should be taken over areas of bony prominences such as the zygoma, glabella, or chin where prolonged freezing may result in a greater depth of freeze than in areas overlying just soft tissue. Generally, the area of skin that should be frozen should be no larger than what can be dermabraded in 15 to 20 seconds. Since the thawing will progress from the most peripheral portions of the freeze to the center, one should begin dermabrading peripherally and progress to the center of the freeze. Care should be taken to occlude the nares or mouth when applying refrigerant in these areas, and the eyes should be protected with a gloved finger or gauze sponge. To avoid lines of demarcation between the successively frozen areas, it is permissible to lightly freeze previously frozen and dermabraded areas to provide a smooth contour. However, care should

be taken to avoid excessive overlap, or the overlapping areas of freezing may give rise to increased skin reaction and possible scarring. Great care should be taken around the nasolabial creases and vermilion border, because injudicious dermabrasion in these areas can give rise to significant scars with webbing. This is particularly true with the wirebrush, and most operators prefer to use pear-shaped diamond fraises with a medium grit to avoid inadvertent injury. Postoperative scarring and pain may be lessened by the application of gauze soaked in 0.5 per cent lidocaine.

Postoperative Care

Dermabraded areas may be covered with a variety of moist occlusive dressings such as Xeroform gauze, plain gauze, fine mesh gauze, Adaptic with Polysporin ointment, Telfa, or Vigilon. For segmental dermabrasions we prefer the simple application of Telfa pads with a light coating of Polysporin on the skin side. These may be secured with paper tape. For full-face dermabrasions Vigilon has proved to be a significant adjunct; it is basically a hydrophilic gel placed between two polyethylene sheets. The polyethylene sheet is removed from one side and the gel is then applied to the dermabraded surface. This significantly reduces pain and provides an occlusive dressing, which allows for more effective reepithelialization underneath the dressing. Telfa and absorbent gauze squares are applied over the Vigilon dressing and secured in place by the use of a Derm-pak "mask". This dressing is then removed and reapplied at 48 hours. The second dressing is removed at 76 hours and no further dressings are usually required. These moist dressings make the abraded area relatively painless by preventing air contact, and the moist dressing prevents crusting, which slows reepithelialization. Once the dressing is removed, patients are instructed to keep the wound moist with a bland, unscented moisturizing cream such as Eucerin, which should be gently applied to moisturize the skin and decrease pruritus. Antihistamines may also be of benefit in cases of severe pruritus. Patients generally require only mild analgesics. By the second week, they may be permitted to wash the area gently with a mild soap. A cream foundation may be used to help disguise the postoperative erythema, which may be prominent for several weeks.

Complications

For practical purposes, the complications of dermabrasion and chemical peeling are very similar; they are discussed at the end of this chapter.

Chemical Peel or Chemabrasion

Chemical peel or chemabrasion, as the name implies, consists of the removal of the superficial skin layers with caustics such as phenol, trichloroacetic acid, or the weaker salicylic acid. Carbolic acid (phenol) was initially introduced to medicine by Sir Joseph Lister as an antiseptic spray in the late 19th century. Subsequently, phenol was employed by both dermatologists and beauty parlor operators to help eradicate wrinkles. Chemical peeling was popularized in the plastic surgery literature by Brown and colleagues in 1960 and later throughout the 1960s by other authors. A variety of solutions are used in chemical peeling, but the formulation of Baker and Gordon, based on phenol, is probably the one most widely used. The main indication for chemical peeling is to reduce or improve rhytids associated with aging. These improvements appear to be brought about by the deposition of new collagen,

which fills in the rhytid furrows. This new collagen is arranged in parallel bundles that are crosslinked, which provides further smoothing and tightening of the skin. The basic component in the Baker and Gordon formula is phenol, but there are several additives believed to enhance its effectiveness.

Histopathology

Phenol causes keratolysis and coagulation necrosis by disrupting the sulfur bonds that give cellular proteins their structure. Under ordinary circumstances the depth of a chemical peel is self-limiting owing to the fact that phenol combines with skin proteins to form a larger molecule, which then restricts phenol's penetrating ability. The depth of phenol penetration in a chemical peel has been determined to be 0.3 to 0.4 mm, which includes the epidermis and upper papillary layer of the dermis; the reticular layer remains intact.

Phenol initially causes blanching of the skin and is followed by skin erythema 1 hour later. Epidermolysis and crusting soon follow, much as in a dermabrasion. Biopsy studies by Litton showed coalescence of collagen fibers in the papillary layer of the dermis at 24 hours and hyperemia, inflammatory reaction, and some coalescence of collagen in the reticular dermis at 48 hours. Epithelial proliferation occurs from deep adnexal structures; by 5 to 7 days epidermal regeneration is nearly complete for the face, and by 10 or more days for the neck. Initially the newly formed skin is hypopigmented and pink owing to increased vascularity and a thinner epidermis. Histologically the absolute amount of melanin is also decreased, just as in dermabrasion, and this contributes to the hypopigmentation. Kligman and colleagues noted that hypopigmentation may be due to either a decreased number of melanocytes or their inability to produce and release melanin. Workers who have been exposed to phenol in factories are also predisposed to developing hypopigmentation at the site of contact, generally on the hands.

After a chemical peel there is considerable collagen remodeling in the dermis, and the fibers become more compact, laminated, and parallel in configuration, giving the newly formed skin its tightness and smoother surface. In summary, the major histologic changes following a chemical peel are (1) increased density and reorganization of collagen, (2) increased elastic tissue, (3) decreased numbers of melanocytes, and (4) increased vascularity. Baker and colleagues (1974), in their 13-year follow-up after chemical peel, noted the above changes to be predictable, consistent, and long-lasting.

Indications

Chemical peel is a useful adjunctive cosmetic procedure that all facial plastic surgeons should have in their armamentarium (Table 3). Its primary indication is to reduce and improve wrinkles and generally tighten the skin; it thus is not particularly useful for redundant skin. It is not a substitute for rhytidectomy or blepharoplasty, but when combined with these procedures can offer a far superior result than either one alone. When a chemical peel is undertaken concurrently with rhytidectomy, it should be performed only on the nonundermined surface. The most common situation is to perform a perioral peel at the same time as the face lift. Alternatively, one should wait at least 3 months if an additional total facial peel is to be performed after a rhytidectomy.

A chemical peel can be performed before rhytidectomy, but one may run into the situation of bringing nonpeeled skin from the neck up onto the face during rhytidectomy, which gives rise to a distinct line of demarcation between peeled and nonpeeled skin. Therefore, it is generally recommended that the rhytidectomy be performed before a chemical peel.

Chemical peeling has also been used successfully for blepharomelasma (dark circles around the eyes) and chloasma of pregnancy. However, when chemabrasion is being used primarily for reduction of pigmentation, other conservative measures should be tried first such as topical application of hydroquinone derivatives. These agents bloc tyrosinase and thereby interfere with the synthesis of melanin. The response to these agents is somewhat slow and may take several months for noticeable results.

Table 3. Indications for Chemical Peel

Major	Minor
Facial wrinkles	Telangiectasia
Blepharomelasma	Senile keratosis
Actinic keratosis	Xanthelasma
Spotty hyperpigmentation	Lentigines.

Chemical peeling has also provided helpful for actinic keratosis and sebaceous keratosis, while avoiding the inconvenience and discomfort of long term 5-fluorouracil treatment.

Contraindications (Table 4)

Phenol is either metabolized by the liver or excreted by the kidney; therefore, a chemical peel using phenol is contraindicated in patients with renal or hepatic disease, because these may predispose them to higher serum phenol levels and systemic toxicity. Since phenol is also cardiotoxic, it should be used carefully in patients with a history of cardiac disease.

Table 4. Contraindications for Chemical Peel

Absolute	Relative
Chemical hypersensitivity	Renal, hepatic, or cardiac disorder
History of keloids	History of herpes simplex
Chronic radiodermatitis	History of hypertrophic scar
Pyoderma	Psychiatric disorder
Malignancy	Vitiligo
	Medications: Valium, Dilantin, birth control pills
	Tattooing.

As in dermabrasion, a chemical peel relies on deep adnexal structures for epithelial regeneration and is contraindicated in areas devoid of pilosebaceous units.

Excessive scarring from chemical peeling has been noted to occur, particularly on the neck and hands, and these areas are probably best avoided.

The appearance of nevi and tattoos may be accentuated by chemabrasion if their pigment is located deep in the dermis, because the peel renders the surrounding skin hypopigmented while not affecting the lesion's pigmentation.

Acne scarring, unless quite superficial, does not generally respond very well to chemabrasion. This is because phenol indiscriminately abrades normal skin and acne pits to the same depth with no subsequent change in levels. In addition, chemical peeling of deep acne pits may result in injury to the deeper reticular dermis with scarring, and thus often no improvement in appearance.

Chemabrasion is also contraindicated in patients taking medications that predispose them to undesirable pigmentary changes postoperatively. A patient on birth control pills should discontinue their intake for at least 1 month before chemabrasion, to avoid the possibility of chloasma.

A chemical peel is a relative contraindication in dark-skinned individuals, especially in males, who generally do not wear makeup and thus cannot camouflage demarcation lines between peeled and nonpeeled areas, which may be quite prominent. Dark-skinned persons may also show splotchy hypopigmentation. If a chemical peel is to be attempted in someone with dark skin, the patient must be made fully aware of these possible complications and should have a test peel performed in an inconspicuous area, such as postauricularly, to obtain an idea of how the facial skin will respond after a chemical peel.

Chemical Peel Solutions

Phenol (carbolic acid) is an aromatic compound with an alcohol group attached to a benzene ring (C_6H_5OH); the OH group gives phenol its acidic properties. The concentration of phenol has to be at least 50 per cent for it to be effective in chemical peeling. Phenol may be used alone for chemical peeling, but other additives are used to enhance its effects. If phenol is used in too high a concentration, the keratocoagulation may be so intense as to prevent adequate penetration.

Toxicity of Peel Solutions

Phenol is readily absorbed through skin and reaches its peak serum level within 1 hour. Studies by Litton (1962) with 3 mL of a 50 per cent phenol solution showed 0.68 per cent mg, 0.19 per cent mg, and less than 0.1 per cent mg serum levels at 1, 2, and 4 hours, respectively, after application of the solution. No true serum toxic level in humans has been determined. However, in one case a 23 mg per cent blood phenol level was reported after accidental ingestion of an unknown quantity of phenol; the patient survived. Thus, given Litton's data, there appears to be a sufficient margin of safety with the peel solutions currently used. Phenol, once absorbed, is conjugated with glucuronic acid and either excreted by kidneys or detoxified by the liver. Baker and colleagues (1974) reported no evidence of systemic toxic effects in 1575 patients.

Signs of systemic phenol toxicity include headache, nausea, central nervous system (CNS) depression, convulsions, shock, and respiratory arrest. Phenol has direct toxic effects on the blood vessels and the myocardium. Truppman and Ellenby (1979) reported the common occurrence of minor cardiac irregularities in conjunction with chemical peeling of large areas of skin. They recommended that a chemical peel be performed on limited areas and that 10 to 15 minutes be allowed approaching another section. Deaths have occurred in the past with phenol chemical peels administered by lay practitioners. Full-face chemical peels with phenol should be performed over at least an hour, with adequate checks of vital signs and continuous ECG monitoring. Furthermore, patients should be adequately hydrated perioperatively to promote excretion by the kidneys.

If phenol comes into contact with the eyes, they should be immediately irrigated with normal saline or balanced salt solution. For unintended skin surface exposure, ethyl alcohol may be used in addition to saline to dilute the phenol concentration. Soap is not effective in removing phenol and may actually enhance its penetration by lowering the skin surface tension.

Patient Selection

Patients must have realistic expectations from the procedure, understanding its risks and the possible complications. They should be informed of the nature of a chemical peel and what to expect in the immediate postoperative period. Unlike other surgical procedures in which there are incisions with suture lines, a chemical peel results, basically, in the removal of the epidermis and superficial dermis of the areas being peeled. The resulting desquamation and crusting can be dramatic and distressing to a patient inadequately prepared for these changes. The surgeon should also carefully evaluate potential patients to determine any psychological instabilities or neurotic tendencies that may be aggravated by the stress encountered during the postpeel recovery. The results of a chemical peel may vary from individual to individual, depending mainly on the type of skin. An ideal candidate for chemical peel is a fair-complexioned individual with wrinkles or pigmentary changes. A chemical peel does not produce as dramatic a result when used alone in a patient with redundant skin or large amounts of subcutaneous fat, and thus adjunctive procedures should be considered. A chemical peel is also useful for diffuse actinic keratosis and superficial acne scars.

Preoperative Preparation

The importance of standardized preoperative photographs for documentation and follow-up cannot be too highly stressed, and these should be standard for all elective cosmetic procedures. Proper preoperative skin preparation is important for the final result of a chemical peel, to ensure maximal penetration of the peel and obtain the best possible result. In addition, a thorough and complete skin preparation guards against peels with areas of variable depth, which can give rise to splotchy skin pigmentation postoperatively. It is important to wash the skin thoroughly several times before the patient is brought to the operating room. This should be done with an alcohol-based soap such as Septisol, which is more effective in removing oils and cellular debris than other soaps. Once the patient is in the operating room, the face is thoroughly cleansed with cotton sponges soaked in acetone, to remove any remaining oils or fats that may be coating the skin. Adequate degreasing and defatting has been achieved when

the skin takes on a gritty feel under the sponges.

To achieve maximal cooperation from the patient and avoid unnecessary discomfort, proper sedation is essential. We generally give patients 15 mg of diazepam and 200 mg of dimenhydrinate orally 1 hour before the procedure. In the operating room patients are given 10 to 12 mg of dexamethasone and 1 gm of cephalothin sodium (Keflin) intravenously. The choice of analgesia and sedation varies from operator to operator. We generally prefer a combination of meperidine and a short-acting benzodiazepine such as midazolam or methohexital, given in incremental doses during the peel. For a peel with intravenous sedation, it is mandatory that the patient be adequately monitored, generally for pulse, cardiac readings, and blood pressure. It is also recommended that patients be monitored for several hours postoperatively with regular blood pressure checks and ECG to make sure that no arrhythmias develop after the peel procedure.

Procedure

The most commonly used peel formula is that developed by Baker and colleagues in the 1960s, which has been shown over thousands of peels to have consistent results with minimal morbidity. The formula is given in the Table 4a.

Table 4a. Various Chemical Peel Formulas

	Phenol (88%)	Water	Croton Oil	Septisol
Baker	3 mL	2 mL	2 gtt	8 gtt
Spira	3 mL	2 mL	3 gtt	6 gtt
Lewis	3 mL	2 mL	5-8 gtt	12-18 gtt.

It is generally recommended that the peel solution be prepared fresh for each procedure. If this is not possible, it should not be allowed to stand for more than 1 week. Because the peel solution is an emulsion, it is important that it be constantly stirred to prevent layering and uneven application. The solution is applied with cotton-tipped applicators that have been pressed against the side of the container to remove excess peel solution that may drip or run, causing an uncontrolled application.

It is usually recommended that the face should be peeled by complete aesthetic units, and spot peeling is generally condemned because of the poor blending with the surrounding nonpeeled areas. The most commonly peeled units are the periorbital and perioral areas and the forehead. The cheeks are usually included in a full-face peel, as is the nose. If a full-face peel is to be performed, it is still recommended that the procedure proceed by aesthetic units in a systemic fashion to ensure an even application of the solution. To avoid the possibility of toxic levels of phenol building up during the procedure, it is recommended that 10 to 15 minutes be allowed to elapse between each peeling procedure. A common order for chemical peeling consists of forehead, individual cheeks, perioral area, lower eyelids, and upper eyelids. If a patient complains of pain during the procedure, it may be helpful to supplement the intravenous sedation just before peeling each of the aesthetic units. We commonly give an additional 2 mg of midazolam before each aesthetic unit to provide maximal sedation and patient comfort.

With application of the solution there should be the immediate appearance of a distinctive white frost. If the frost is not observed, it may be that the skin has been inadequately cleaned and there are oils and fats preventing adequate contact of the peel solution with the skin. At this point, one should consider recleaning the area for proposed peeling with acetone.

One of the major disadvantages of a chemical peel is the fairly distinctive lines of demarcation between the areas that have been peeled and nonpeeled skin. Thus, every opportunity should be taken to use anatomic structures to camouflage the lines of demarcation between peeled and nonpeeled skin. When the forehead area is peeled the peel solution should be feathered into the frontal and temporal hairlines to prevent a line of demarcation developing in front of the hairline. The peel solution does not affect the hair follicles and there have been no reported incidences of alopecia after chemical peeling. Similarly, the solution should be feathered into the eyebrows to provide further camouflaging. We generally bring the peel solution under the earlobe and into the immediate postauricular region as additional camouflage.

For cheek peeling the solution should be feathered over the angle of the mandible into the immediate submental region. This allows the line of demarcation to be hidden in the submental shadow. However, one should not proceed onto the neck itself; there have been reports of hypertrophic scarring after peels of the neck. The perioral area is generally characterized by fairly pronounced vertical rhytids around the lips. There also are fairly deep and prominent melolabial and nasolabial creases. These generally require additional application of peel solution to provide maximal depth of penetration and best results. Generally, deeper creases are addressed separately, the sharpened end of an applicator stick being soaked in the peel solution and applied directly to the rhytids before the rest of the area is peeled. The entire area is then peeled in the standard fashion. The peel solution is applied right up to the edge of the vermilion border and actually feathered into the vermillion of the lip itself. This causes some postoperative lip edema, but provides much better camouflaging than when attempts are made to stop the peel at the vermilion border. Again, the solution should be brought into the submental area to camouflage the line of demarcation with the submental shadow. To obtain maximal penetration of the peel solution into these deeper perioral rhytids, it may be necessary to stretch the skin and work the solution in fairly vigorously with the applicator.

When the periorbital area is peeled, great care should be taken to avoid inadvertent entry of the solution into the conjunctival sac. A balanced salt solution should be available to provide immediate irrigation should an inadvertent spill occur. In addition, the applicator or the peel solution should never pass directly over the periorbital area, but should always be handed or moved in a circle around the eyes. There is also the theoretical possibility of the peel solution traveling back along a stream of tears and entering the eye in this manner. Thus, tears should be gently dabbed away as they appear, to prevent migration of the solution along the tear stream. Also, tears flowing over an area with fresh solution on it may alter the depth of the peel, either providing for a deeper peel or, more commonly, diluting the solution and giving rise to an inadequately peeled area. Since the skin is thinner in the periorbital region and has relatively less sebaceous units than the rest of the face, care should be taken over the amount of solution that is applied to the skin. Generally, it is preferable to have a relatively dry applicator with just enough solution to bring about the white frost, but with no excess

solution on the applicator. The solution is taken to approximately 2 to 3 mm inferior to the inferior lid margin. For the upper lid the patient is asked to close the eyes and the solution is carried to the superior portion of the tarsal plate, which corresponds to the tarsal crease. If there is excessive skin of the upper lid, the peel will not be successful, and it is generally recommended that an upper lid blepharoplasty be performed before peeling individuals with significant blepharochalasis.

Postoperative Care

In the immediate postoperative period, patients are maintained on intravenous fluids and monitored for approximately 2 hours after the procedure to make sure there are no late cardiac sequelae. During this period, patients may complain of burning or stinging and may require additional sedation or analgesia. It was once advocated by some authors that the peeled areas be "taped", which was thought to enhance the penetration of the peel and provide better results. However, a major disadvantage of taping is the need for tape removal, which is quite uncomfortable and frequently requires a second anesthetic. The tape also becomes a hygienic problem because of the accumulation of debris and serious drainage. We prefer to employ the nontaping method advocated by Beeson and McCollough, which basically consists of liberal application of a moist dressing of Eucerin skin cream to the peeled areas; this is washed off in the shower several times a day. It prevents the accumulation of crusting and provides a moist environment for maximal reepithelialization.

The patient should be followed closely for surveillance of any untoward reactions. It is at this point that preoperative counseling and education become important, since the drastic changes that occur within the immediate postoperative period can cause anxiety. Firm, gentle reassurance that all is well and that there are no complications will go a long way toward alleviating fears. Fluids should be encouraged and adequate analgesics prescribed. In addition, as the peeled skin starts to heal, there are variable amounts of pruritus, and an antihistamine such as diphenhydramine (Benadryl) may be useful.

The vast majority of the crusting should resolve by the fifth to sixth postoperative days. By the seventh or eighth day there should be complete reepithelialization of the peeled areas, leaving new, pink epithelium. This regenerated epithelium may still be somewhat sensitive and delicate and initially may suffer minor trauma. However, it rapidly solidifies, and within 10 to 12 days patients are allowed to wear bland, unscented makeup to help camouflage the intense pink color that occurs in the postpeel period.

As with dermabrasion, patients should avoid sun exposure if possible; if such exposure seem unavoidable, they should use appropriate sun screens for at least 4 months. The intense erythema generally fades over the following 4 to 6 weeks, but may persist for several months after the procedure.

Postoperative Complications of Dermabrasion and Chemical Peel (Table 5)

Table 5. Possible Complications of Dermabrasion and Chemical Peel

Common	Rare
Hypopigmentation	Foreign body granuloma
Hyperpigmentation	Full-thickness skin loss
Milia	Scars and contractures
	Herpes labialis.

Hypopigmentation

After the immediate postoperative erythema fades, initial hypopigmentation is an expected outcome, not really a complication. The color of the peeled or dermabraded area is generally lighter than that of the neighboring areas. For this reason, patients with lighter skin are generally better candidates for these procedures. However, there should be some gradual return of pigmentation, which may take 4 to 6 months. During this period, patients should avoid sun exposure and use a sun screen to prevent splotchy hyperpigmentation. Permanent hypopigmentation may result from a deep chemical peel or dermabrasion, particularly in darker-skinned individuals; patients should be informed of this possibility before the procedure is performed.

Splotchy Hyperpigmentation

Splotchy hyperpigmentation may have many causes, including uneven application of peel solution, failure to adequately defat the skin with variable depth of penetration of the solution, dilution of the peel solution by tears running down the side of the cheek, or simply the natural healing process. Patients taking oral estrogen or phenytoin are more predisposed to hyperpigmentation of pregnancy. Generally, residual areas of hyperpigmentation may be improved with a repeat chemical peel and proper application of the solution, or a bleaching agent such as 2 per cent salicylic acid or a hydroquinone cream.

Scars and Contractures

Perhaps the most feared complication of a chemical peel or dermabrasion is an inadvertent full-thickness skin loss and the scarring that may accompany this. Spira and colleagues encountered several patients with full-thickness skin loss, in every instance associated with another procedure performed concurrently with the chemical peel. These included perioral peels performed in conjunction with face lifts using extended undermining, and a forehead peel in conjunction with a forehead lift. Once a full-thickness skin loss has occurred, little can be done acutely. It is generally recommended that the area be treated conservatively with simple debridement as necessary. If scarring or webbing appears to be developing, topical steroid creams or intrascar injections may be beneficial. Scarring following dermabrasion is almost always due to too deep a dermabrasion. As mentioned, this is more likely when wire-brushes are used. Again, once the injury has occurred, little can be done acutely. Small doses of steroids may be beneficial for softening scars and loosening webbing.

Telangiectasia

Telangiectasia generally is not caused by the chemical peel or dermabrasion but may appear more prominent after the procedure. The reason appears to be twofold; first, telangiectasia may be enhanced because of the increased vascularity associated with the procedure, and second, it may be a result of the loss of pigmentation that may have partially obscured the lesions before the procedure. It is best to forewarn patients of these possibilities. There is no completely satisfactory treatment for telangiectasia, but electrocoagulation or argon laser treatments have been described as useful for limited, selected lesions.

Milia

Milia are small epidermal inclusion cysts caused by occlusion of the smaller pilosebaceous units during the healing process. They generally present as small, round, whitish lesions covering the peeled area. They are generally treated by simple curettage and externalization of the lining of the cyst. This is generally a self-limited problem that heals without incidence once the lesion has been uncapped.

Herpes Labialis

As mentioned, all patients being considered for a chemical peel or dermabrasion should be screened for the presence of herpes labialis or a history of herpetic-type infections. It is well known that denuding of the facial epidermal surface may activate the virus and result in a herpetic infection. In addition, with the loss of the protective epidermal layer, the herpetic infection may progress over the peeled or dermabraded surface. For this reason, patients with a history of herpetic infections are pretreated with oral acyclovir. Occasionally, a patient with no history of herpetic infections develops a herpetic type of infection after a chemical peel. For these, it is helpful to begin oral acyclovir as soon as the diagnosis is made. We have no experience of full-thickness skin loss secondary to herpetic infection, but it does prolong the healing time somewhat. It is also recommended that antibiotics be given to patients with a herpetic infection to prevent superinfection of the lesions with local bacteria.