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REVIEW ARTICLE

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Insights on in-office scar revision and resurfacing procedures

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Abstract

Objective: Many facial plastic surgery procedures can be performed in an office-based setting, ranging from simple chemical peels to reconstructive surgeries to assist with scar revision. The aim of this review is to summarize the current state of facial plastics in-office surgical procedures, including scar revision, dermabrasion, lasers, and chemical peels.

Methods: A literature review was conducted with the PubMed search engine with the following keywords: facial plastics, scar revision, dermabrasion, lasers, chemical peels, face, office, and outpatient. The literature was surveyed for relevance, with a focus on realistically which procedures were performed in a facial plastics surgery outpatient clinic. These were then used to compile a review of the current state of this field.

Results and Conclusions: There are various scar revision procedures that can be performed in the office setting, including z-plasty, w-plasty, and geometric broken line closure techniques, as well as various nonmedical treatment options to improve the appearance of a scar. Dermabrasion can also be performed to assist with elevated scars. Various lasers are available to enhance cell turnover in the field of facial rejuvenation, scarring, and sun damage. Chemical peels are also available to assist with facial rejuvenation. With the appropriate counseling of the patient and medical staff, these can be safely performed in the office.

KEYWORDS
chemical peel, dermabrasion, laser, office, scar revision

Key points

- Medical and surgical treatments of scar revision, dermabrasion, laser therapy, and chemical peels can be performed in the office with proper patient counseling.
- This review describes the current use of in-office procedures to address scarring, facial rejuvenation, and sun damage.

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INTRODUCTION

Scarring risk is a component in many—if not all—surgeries, and it is important for the surgeon to be equipped with the knowledge on how to prevent and treat unsightly scars. Several office-based procedures can be performed to treat scars, in addition to other common aesthetic concerns, which include nonsurgical and surgical scar revision, dermabrasion, laser therapy, and chemical peels.

These procedures can be performed with the use of topical, injected, local nerve blocks, and tumescent local anesthetic agents.[1] Topical anesthetics are often useful for areas of large perfusion, such as the scalp and the face, given the high absorptive capacity.[1] Additionally, topical anesthetics are often employed for laser procedures or with a combination of nerve blocks or locally injected anesthetic agents.[1] Infiltrative local anesthetics, such as lidocaine, often contain epinephrine, a potent vasoconstrictor that prolongs the anesthetic effect, acts as a hemostatic agent, and decreases the peak blood level of lidocaine systemically.[1] Improper application of topical anesthetics leads to serious complications. It is important to understand the limitations and pitfalls of utilizing local anesthetic agents in the office. Inappropriately high concentrations and application over large surface areas before outpatient procedures carry the risk of cardiotoxicity and damage to the central nervous system.

SCAR REVISION

Scars can result from a multitude of etiologies such as trauma, acne, or as a result from surgery. Various treatments exist for scar revision and include both nonsurgical and surgical options, both of which can be performed in clinics under local anesthesia in select patient candidates.

Nonsurgical treatments

Pressure therapy

Pressure therapy gained popularity in the 1960s as a way to decrease swelling and blood flow to the injured area, thereby thinning the dermis and creating an environment depleted of oxygen, decreasing fibroblast activity and collagen production.[2] It was also found that pressure therapy seemed to decrease circulating tumor growth factor-β (TGF-β), which is responsible for myofibroblast differentiation and can thus minimize wound contracture.[2]

Silicone gel

Silicone gel sheeting or creams can improve the appearance of scars, though the mechanism of action of this treatment is still debatable. Some speculate that silicone gels enhance the hydration of the most superficial layer of the epidermis, the stratum corneum.[2] However, there is controversy regarding the effect of silicone gels on fibroblast production as both increased and decreased expression of fibroblasts have been reported.[2] Nonetheless, its ability to hydrate keratinocytes resulted in decreased collagen deposition and thus decreases the thickness of the epidermis and dermis to thin a more hypertrophic scar.[2]

Onion extract

Onion extract (e.g., Mederma; Merz Pharamceuticals, LLC) is an often recommended over-the-counter topical medication to address scars.[2] Onion extract has anti-inflammatory and bacteriostatic properties while reducing the production of collagen.[2] Despite its commercialized popularity, current literature has failed to show any significant difference between the effects of onion extract and petrolatum-based ointment on improved scar cosmesis.[2]

Corticosteroids

Raised scars, such as hypertrophic scars and keloids, are often first addressed with intralesional corticosteroids, primarily triamcinolone acetonide.[3] In addition to its anti-inflammatory properties, corticosteroids minimize fibroblast and collagen synthesis and also decrease the production of α1-antitryptin and α2-macroglobulin, which are involved in keloid formation and are inhibitors of collagenase,[2,4] TGF-β1, and TGF-β2.[5] The initial dose for triamcinolone acetonide is usually between 5 and 20 mg/mL but can be increased up to 40 mg/mL depending on the severity of the scar being addressed.[2,5] Injections can proceed serially every 2–4 weeks.[2,5] Complications include epidermal atrophy if injected too superficially, hypopigmentation, delayed wound healing, scar widening, and telangiectasias.[2,5]

5-Fluorouracil

5-Fluorouracil is a chemotherapeutic agent that has recently gained popularity in the treatment of hypertrophic scars and keloids.[4] This medication inhibits TGF-β2 in fibroblasts, preventing increased collagen production and deposition.[4] 5-Flurouracil can be injected in the immediate postoperative phase in patients with a history of hypertrophic scars or keloids.[4] 5-Fluorouracil is often injected in conjunction with corticosteroids as it has been shown to decrease some of the adverse effects of corticosteroids, such as hypopigmentation and skin atrophy, and produce a more accelerated scar response.[2] Adverse effects of 5-fluoruracil include erythema, edema, pain, hyperpigmentation, and ulcers; thus, patients should be counseled accordingly.[2,5]

Imiquimod

Imiquimod cream is applied topically to scars, activating the proinflammatory cytokine, interferon-α, which promotes collagen

breakdown.[2] The most commonly reported use of imiquimod is after excision of keloids to prevent their recurrence.[2] Treatment results of imiquimod have been controversial. As noted in Thomas and Somenek's review on scar revision, Berman and Kaufman performed surgical excision of 13 keloids from 12 patients and then applied imiquimod nightly for 8 weeks.[2] After 24 weeks, six patients had no keloid recurrence.[2] However, another study conducted by Malhotra and colleagues revealed a complete recurrence of keloids within 4 weeks of imiquimod cessation.[2] Thus, caution must be used in the reliance on imiquimod as a sole treatment option for keloids. Adverse effects of imiquimod are rare but can include irritation and hyperpigmentation.[2]

Surgical scar revision

Fusiform excision

In cases of a standing cutaneous deformity, misalignment of skin edges, or increased tension, a fusiform, elliptical incision in a 3:1 ratio surrounding the scar can be performed to excise the scar.[3,5] Additionally, this technique can be utilized for scars that are present along a resting skin tension line (RSTL) but are depressed or wide.[5] The skin edges can then be re-approximated in a tension-free closure.[3]

Z-plasty

Z-plasty (Figure 1A) is the most commonly used technique for scar revision in scars, which are at least 30° from an RSTL,[5] contracted, webbed, or have a trapdoor orientation.[2,5] While the z-plasty technique helps to reorient the scar in a more favorable position, the surgeon is in turn creating two additional scars, which are longer than the original scar.[5] Z-plasty serves as a transposition flap in which the scar to be revised is the diagonal central limb with two peripheral limbs equal in length and are drawn parallel to one another.[6] The angles between the peripheral limb and central limb can vary between 30°, 45°, and 60°.[5] The angle between the central and peripheral limbs determines the elongation of the resultant scar such that an angle of 30° lengthens the scar by 25%, 45° by 50%, and 60° by 75%.[5] Furthermore, z-plasty allows for the reorientation of a scar

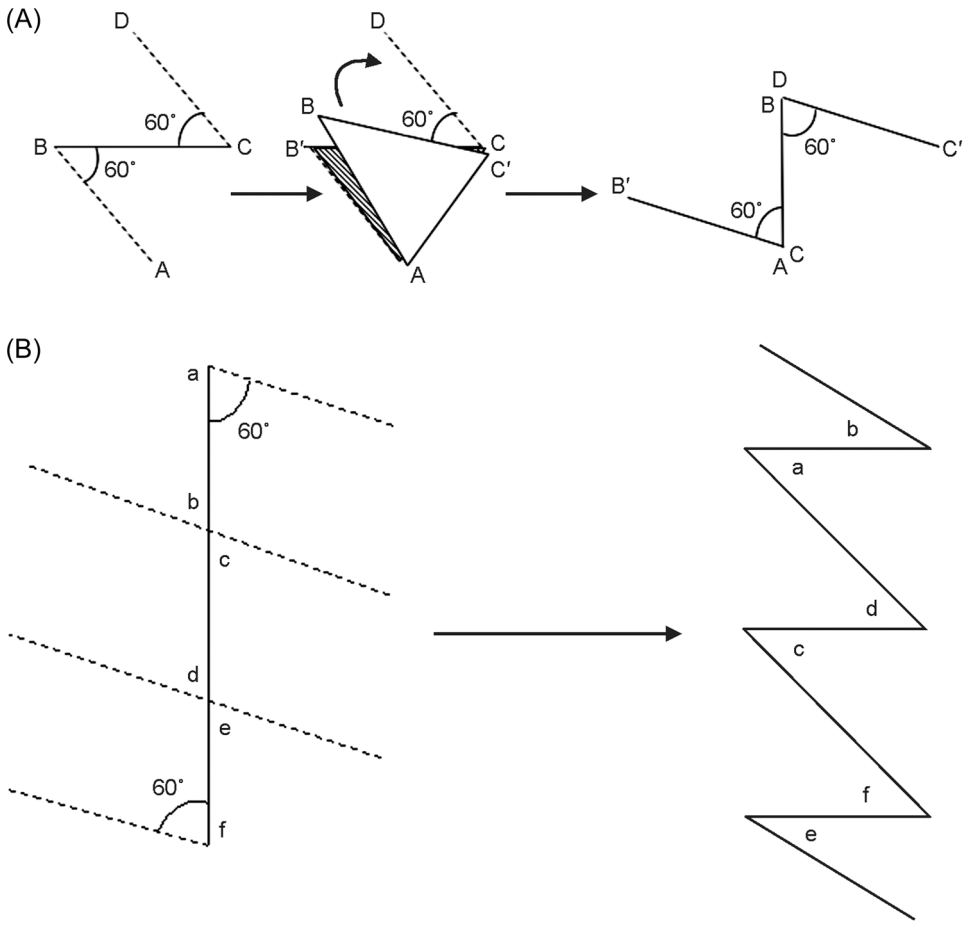

FIGURE 1 Variations of the z-plasty. (A) Simple z-plasty. The simple z-plasty is shown, with an angle of 60° for rotation, with the solid line on the leftmost image indicating the original scar and dotted lines indicating the peripheral limbs. Additional angles of 30° and 45° can also be used. (B) Multiple z-plasty. The multiple z-plasty is shown, which can be useful in situations of longer scars in areas of inelasticity of the face. The solid line is the elongated scar, and the dotted lines are the peripheral and transecting limbs that are designed for the transposition flap.

within a RSTL.[7] For example, in a z-plasty with 30° angles between each limb, the scar is rotated 45°, a 45° angle of the z-plasty results in a 60° rotation, and a 60° angle results in a 90° rotation from the original scar position.[7]

One variation of the traditional z-plasty is the multiple z-plasty technique (Figure 1B), which is indicated for larger scars and in an area of inelasticity.[5] In this technique, the long scar is divided into smaller segments that each undergo a traditional z-plasty.[5] The peripheral limbs are all parallel to one another and are in a three-sided rhomboid orientation.[6] The resultant scar has a zig-zag shape that is concealed well within the skin under minimal tension with an increased length.[5]

W-plasty

The w-plasty (Figure 2) is an interposition flap that does not create scar lengthening.[2] The w-plasty is ideal for scars greater than 2 cm, are greater than 35° from the RSTL, are short in areas where there is increased laxity, and scars over curved areas.[5,6] W-plasty involves creating sequential, consecutive triangles surrounding the scar, with the contralateral sides being reflections of each other.[5,6] The design of this flap causes normal, healthy tissue to be excised in addition to the scar and creates a regularly repeating pattern, which can occasionally be more noticeable.[3]

Geometric broken line closure

The geometric broken line closure (Figure 3) is an interposition flap that is indicated for longer scars that are greater than 45° from an RSTL and concave or convex scars.[2,5] This scar revision technique involves randomly oriented shapes around a scar that mirror the contralateral side so that the closure results in an irregularly irregular scar that is less conspicuous.[2,5]

Subcision

Depressed scars can be treated with the subcision technique, which can be performed under local anesthesia.[8] Local anesthesia can be achieved through topical application of lidocaine cream and/or injection of lidocaine. An 18- or 20-gauge tri-beveled hypodermic needle is used to create a puncture into the skin surface and advanced into the deep dermis, traversing back and forth under the scar to release the fibrous bands.[8] Sessions can be repeated every

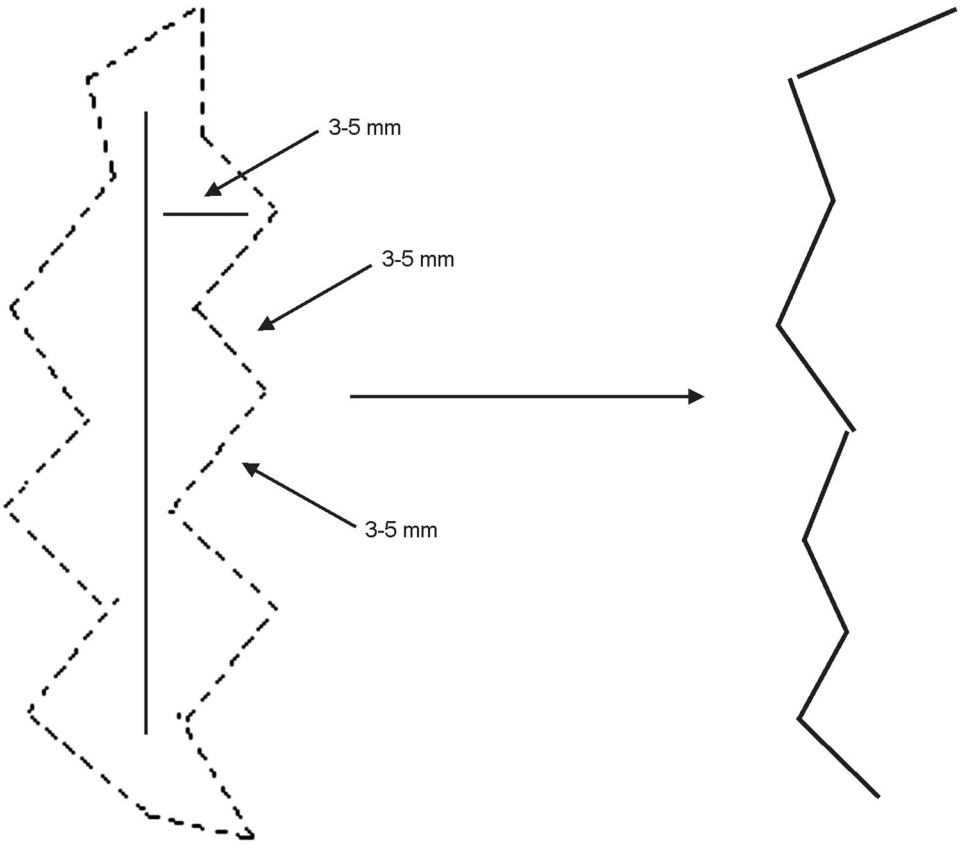

FIGURE 2 w-plasty. The w-plasty is shown above, which is ideal for shorter scars in areas of increased laxity and are greater than 35° from a resting skin tension line. The solid line is the scar of interest, and the dotted lines are the triangular limbs created in the w-plasty. Note, the surrounding skin is excised with the triangular limbs to create a new closure in a zig-zag formation, which is less noticeable.

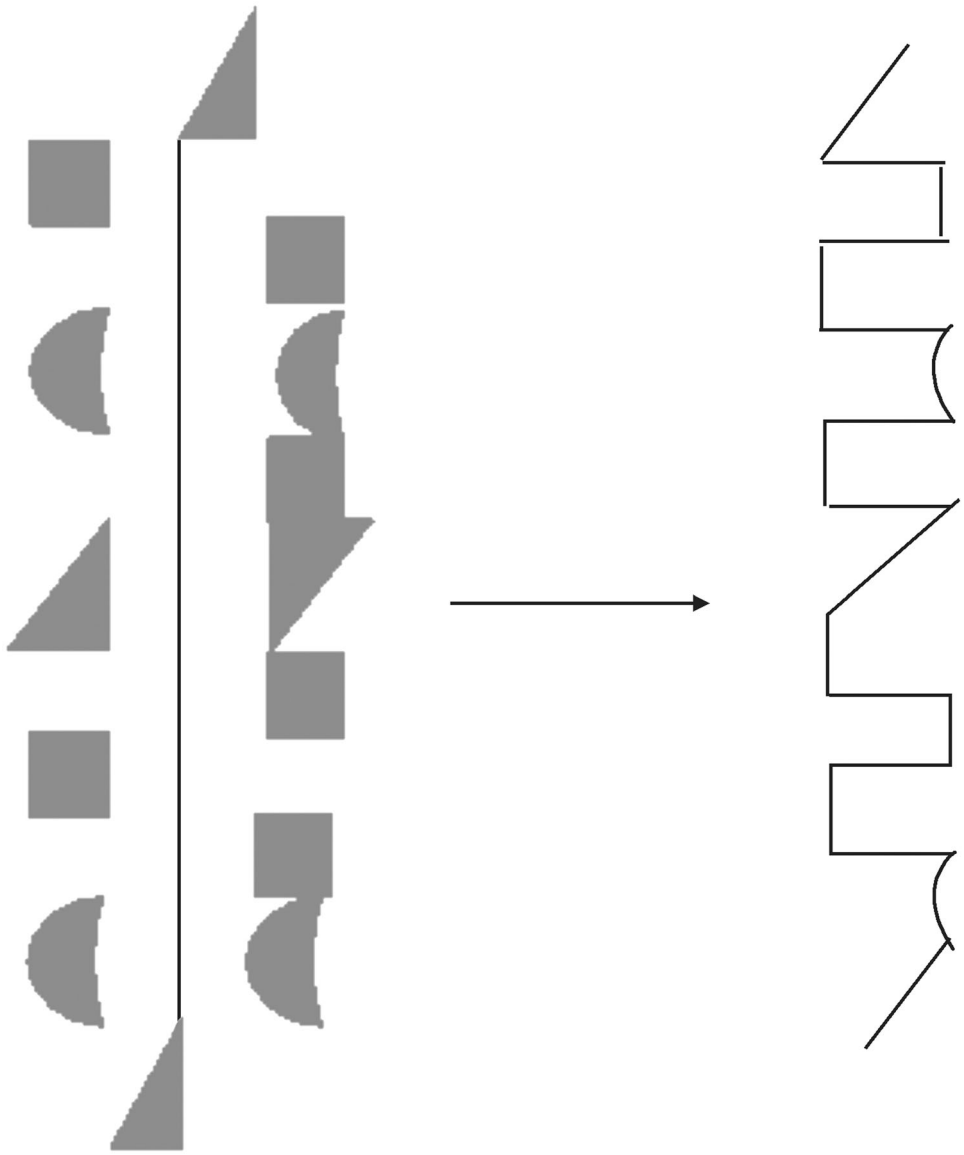

FIGURE 3 Geometric broken line closure. A series of semicircles, triangles, and squares or rectangles can be used to randomly create a defect to be closed primarily. This scar revision technique is best suited for longer scars that are situated 45° from a resting skin tension line.

3 weeks, and it is important to know the course of the facial nerve, especially in the preauricular, temporal, and mandibular regions to avoid facial nerve injury.[8]

Dermabrasion

Dermabrasion is a nonsurgical technique employed in the office for elevated scars or contour abnormalities.[2] The concept of dermabrasion focuses on the regenerative properties of the skin such that ablation of the superficial epidermis, papillary dermis, and superficial reticular dermis is exposed, allowing the exposed wound to undergo epithelial regeneration from the deep basal cells from the surrounding adnexal structures.[2] Dermabrasion can be utilized as an adjuvant treatment to scar revision procedures, approximately 6–8 weeks after repair.[2] The utility of dermabrasion in the office ranges based on the depth of treatment and the pain tolerance of the patient. Superficial dermabrasion is more likely to be tolerated with an awake patient following the application of only a topical anesthetic cream. Injection of local anesthesia should be considered as well with deeper treatments.

The scar and surrounding skin are injected with local anesthesia, which assists in pain control but also with assistance with the surgeon's control of the dermabrader.[9] The skin can then be prepped with a marking pen, which stains the epidermis and allows the surgeon to visualize once the epidermis has been ablated during the procedure.[9] The dermabrader and diamond fraise are then stroked gently at a 45° angle from the scar on the first pass and then perpendicular to the initial dermabrasion stroke on additional passes.[9] Dermabrasion continues until pinpoint bleeding results,

signifying entry into the papillary dermis, followed by the visualization of yellow tissues with white strand-like cords, which signifies entry into the superficial reticular dermis.[2,9] The deep reticular dermis is not penetrated to avoid additional scarring.[9]

Microneedling

Similar to dermabrasion, microneedling, also known as percutaneous collagen induction therapy or needle dermabrasion, can also be used for scar revision and is considered minimally invasive with little downtime.[10] Microneedling devices include rollers, stamping tools, and pens with a variation in needle lengths that cause differences in penetration depth.[10] Furthermore, the depth of penetration can also be increased with the use of radiofrequency devices to penetrate into the dermis.[10] Microneedling can also be combined with platelet-rich plasma and chemical peels for added skin renewal benefits.[10] Various indications include acne scarring, hypertrophic scars, keloids, rhytids, and striae.[10]

Lasers

Lasers may be used alone or in conjunction with surgical procedures and are used commonly to treat pigmentation, redness, wrinkles, acne, scars, and skin laxity. They denature collagen by providing enough thermal energy at about 60–65°C to shorten collagen fibers while preserving hydrogen bonding, thus tightening the skin while maintaining elasticity.[11,12] Thermal injury also encourages fibroblasts to build new collagen.[12] In the office setting, pain associated with treatment by laser can be minimized with topical lidocaine-containing anesthetics.[13]

Lasers can be categorized as ablative or nonablative and fractionated or unfractionated.[14] Ablative lasers vaporize tissues and disrupt the epithelium.[14] Nonablative lasers leave the epithelium intact and act only on the dermis.[14] Ablative lasers have a longer downtime and more difficult recovery but deliver more substantial results and can be used to treat more severe cases of rhytids, dyspigmentation, textural changes, and scarring.[14] Fractionated lasers act on only a percentage of the area treated, whereas unfractionated lasers act on the entire treated surface.[14]

Ablative skin resurfacing procedures can be quite painful and often require the use of intravenous sedation before the use of topical analgesics.[15] Use of a cooling device or ice before the procedure can help lessen the perceived pain.[15] Less aggressive ablative laser procedures (e.g., fractional laser) have allowed reasonable anesthesia with topical anesthetics.[15] Given the deeper penetration in the skin with ablative lasers, a topical anesthetic is recommended for at least 60 min before treatment.[15] The anesthetic can then be removed with the skin cleansed and dried for appropriate application of the laser.[15]

Ultimately, depending on the resources available, oral agents for sedation (e.g., benzodiazepine) and regional nerve blocks may be administered to provide even greater analgesia during laser procedures.[15]

A few of the most common office-based laser therapies are described below.

10,600 nm CO_2 laser

This was the gold standard laser for the treatment of rhytids, dyspigmentation, acne, and scarring in the early 1990s and 2000s.[12,14,16] The CO_2 laser is an ablative laser with fractionated or unfractionated modes. CO_2 lasers work on the chromophore water and vaporize tissues by heating water molecules into gas.[12,14,16] The 10,600 nm CO_2 laser works well on fine wrinkles around the eyes or mouth and on scarring.[12,14,16] Downtime is about 2 weeks, and side effects include redness, pain, swelling, infection, and hypo- or hyperpigmentation.[12,14,16]

2,940 nm Er:YAG laser

This is an ablative laser that is the most effective on skin resurfacing with the longest downtime.[16] Similar to the CO_2 laser, its target chromophore is water, and it is commonly used for the treatment of rhytids, atrophic scarring, and dermal and epidermal lesions.[16] This laser has a more precise impact with less surrounding tissue damage than previous CO_2 lasers and has a 13–16 times higher absorption by water than that of the CO_2 laser.[16] This allows for instant tissue vaporization and a more targeted ablation directed at the epidermis and dermis.[16] An adjacent untreated tissue is thought to aid in quicker re-epithelization.[16] Re-epithelization occurs in 7–10 days, but redness may persist for up to 6 months.[12]

Pulsed-dye laser

The pulsed dye laser (PDL) acts on the hemoglobin chromophore at 585 or 595 nm to decrease microvasculature in the dermis.[17] It is often used to devascularize hypertrophic scars to induce tissue hypoxia and neocollagenesis.[17] Additionally, the PDL laser has been shown to improve the erythema and hyperpigmentation associated with photodamage due to vascularity being a prominent target of this therapy.[16] The most common side effects are purpura, which may last up to 7 days, and inflammation, lasting up to 48 h.[18] Hyperpigmentation may also occur and further treatments should be postponed until this resolves.[18] Though there is a vasoconstrictive consequence to using prilocaine-based creams to numb the area before treatment, it is an effective way to reduce the associated pain with treatment.[13]

Chemical peels

Chemical peels are another technique that can be used either in the office for skin rejuvenation. Chemical peels work by applying ablative chemical agents to the skin surface that promote the regeneration of normal skin. They are classified as superficial, medium, and deep based on their depth of penetration. The use of topical anesthetic medications before a chemical peel will reduce pain and maintain the peel's efficacy.[19] Topical lidocaine has been studied in the setting of a

superficial 70% glycolic acid peel and a medium-depth 35% trichloroacetic acid (TCA) peel, revealing no reduction of the clinical outcomes.[19] There is however a risk of inadvertent risk of excessive absorption of lidocaine if applied after a deeper peel.[19]

Patient selection is important when using chemical peels. Darker skin types are more prone to adverse effects such as hyperpigmentation, and effects may vary by skin thickness.[20] A proper medical history should be noted, as relative contraindications include smoking history, diabetes, active herpes simplex virus (HSV), recent use of isotretinoin, and cutaneous radiation history.[21] Furthermore, caution must be taken when treating patients with a history of hypertrophic or keloid scarring.[21] It is important that the patient understands that he or she will need to refrain from prolonged sun exposure for about 3 months following the chemical peel and that sunscreen use should start 3 months before treatment.[21] Many times, the patient is also started on topical tretinoin weeks before, to aid in uniform application and potentially enhance the effects of the peel.[21] Patients with a darker skin type or dyschromia may also begin using hydroquinone pre- and postpeel, which decreases melanin production.[21] Patients may also be started on a prophylactic dose of antivirals and antibacterials periprocedurally, to reduce the risk of HSV and bacterial infection.[21]

Some peels require a neutralizing agent such as normal saline or sodium bicarbonate at the end of treatment to terminate the reaction.[22] Others may cause frosting, which is the whitening of the skin caused by protein coagulation.[22]

Superficial peels penetrate the epidermis and papillary dermis and are most commonly used to treat mild skin disorders including melasma, postinflammatory hyperpigmentation, acne, dyschromia, and actinic keratosis.[20] Examples of superficial peels include 10%–30% salicylic acid (SA), 20%–70% glycolic acid (GA), Jessner solution, and <20% TCA.[22] There is little to no downtime with superficial peels.

Medium peels target the papillary to the upper reticular dermis and are commonly used to treat solar keratosis or lentigines and scars as well as static wrinkles.[20] Examples include TCA 35%–50%, TCA 35% in combination with GA 70%, and Jessner solution.[19] Downtime for medium peels is about one week.[21]

Deep peels penetrate the mid-reticular dermis and can be used to treat photoaging, deep scars or rhytids, and precancerous lesions.[17,23] They should be performed at an ambulatory surgery center, as systemic toxicity can result from cutaneous absorption, such as arrhythmias.[24] Thus, deep peels will not be covered in this review.

Peeling agents

Salicylic acid

Salicylic acid (SA) is a β-hydroxyl acid used as a superficial peel that works to shed epidermal cells, neutralize bacteria, and desquamate the upper lipophilic layer of the stratum corneum.[20,23] It is most commonly used in the treatment of acne given its antimicrobial, comedolytic, and anti-inflammatory properties.[20,23] Concentrations of 5%–30% of SA are most commonly used safely and are self-limiting.[20,23] They do not require the use of neutralizing agents but may precipitate a "pseudofrost" that is easily removed from the skin.[20,23]

Glycolic acid

Glycolic acid (GA) is the most common α-hydroxyl acid that can be used as a superficial or medium-depth peel.[22] It works by causing epidermolysis and desquamation by reducing corneocyte adhesion and keratinocyte plugging at the stratum granulosum.[20] It also has bactericidal and anti-inflammatory properties, making it a good choice in the treatment of acne.[20] Concentrations of 20%–70% are commonly used; however, neutralizing agents must be applied.[20,22]

Lactic acids

Lactic acid (LA) is used as a single agent superficial peel or in combination with other solutions.[20] Alone, it works to thin and regenerate the stratum corneum.[20] It also inhibits tyrosinase, which decreases melanin synthesis leading to skin whitening.[20] It can be used in the treatment of melasma and hyperpigmentation.[20]

Trichloroacetic acid

Varying concentrations of TCA can make these peels either superficial, medium, or deep.[20] TCA works to denature proteins found in the dermis and epidermis, destroy dermal collagen, and cause coagulative necrosis of epidermal cells.[20] It increases glycosaminoglycans and elastin in the dermis, which help keep the skin hydrated and youthful. It also causes coagulative necrosis of the epidermis.[20] TCA can be used for focal treatment of lesions.[23] At concentrations of 35% or below, TCA acts as a superficial peel; however, it is commonly paired at 35% with Jessner solution or GA to act as a medium peel.[24]

Jessner solution

This is a superficial peel made up of 14% SA, 14% resorcinol, and 14% LA 85% in 95% ethanol.[20] It can be used in combination with other peels to penetrate deeper into the skin.[20] The solution will exfoliate the stratum corneum if 1–3 layers are applied but will penetrate to the basal layer with 5–10 coats.[21] Jessner solution will trigger frosting but does not require a neutralizing agent.[21] It may be used before a TCA peel.[21]

CONCLUSION

Various nonsurgical and surgical scar revision procedures, dermabrasion, laser therapy, and chemical peels can be provided in the office setting in facial plastic surgery clinics. These are generally well tolerated under local anesthesia with minimal to a couple of weeks of recovery time.

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Not applicable.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no data sets were generated or analyzed during the current study.

ETHICS STATEMENT

Not applicable.

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