Laser treatment for post acne scars– A review

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ABSTRACT

Background: For years, there was no successful treatment for acne scars. Now, things have changed. With the development of new technologies, those suffering from acne scarring have multiple options to improve the tone and texture of the skin. Laser treatments, including ablative and non ablative laser skin resurfacing are among available treatment options.

Methods: The aim of writing this paper is to review information about acne scarring, as well as potential treatments by laser. The paper will first concentrate on introduction and classification of acne scarring, then go on to treatment modalities specifically by laser. This paper will also focus on post treatment recovery time, side effects and methods to prevent and treat those side effects.

Conclusion: Ultimate goal of any intervention in acne scarring is not total cure or perfection; rather it is making scars less visible.

Keywords: Acne scar; laser treatment; post treatment recovery

Introduction:

The term "**scarring**" refers to a process where collagen within the skin is damaged from inflammation, leading to permanent texture changes in the skin. Post acne scars are the result of compromised collagen production during the natural wound healing process, resulting in topographic depressions. Additionally, in skin with acne scarring, there are perpendicular bundles of collagen that anchor the skin of the scars. Histologically, post acne scars are usually limited to the epidermis and upper papillary dermis and, thus, amenable to treatment with a variety of techniques including ablative and non ablative lasers for skin resurfacing. Resurfacing procedures for many decades have been considered to have pre-eminence, but they should not be considered in isolation, and one needs to combine modalities to maximize outcomes.[1] Given the dermal pathology present with acne scarring, particularly with atrophic scars, this condition can be difficult to treat effectively without using treatment modalities capable of affecting dermal remodeling at least 1 mm below the skin surface.[2]
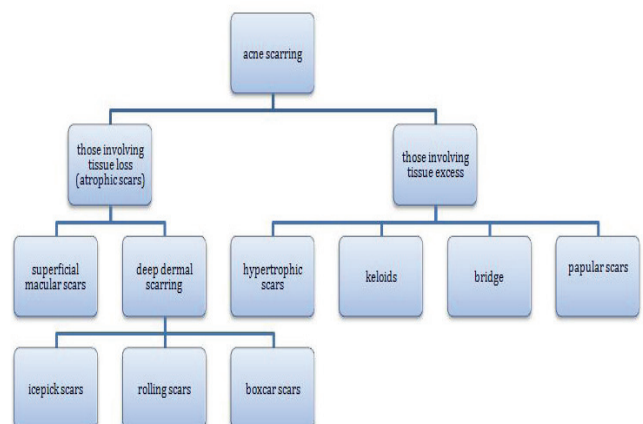
Classification of acne scar

Figure 1 : Classification of acne scar

1. **Those involving tissue loss (Atrophic scars):** Atrophic scars are broad, shallow, saucer-like indentations that result from loss of collagen deposition during the wound-healing process of acne lesions. They are more common than hypertrophic scars and keloids.

1.1. **Superficial macular scars:** These scars may appear as macules that may be discoloured, either erythematous if inflamed and comparatively early or young scars (under 1 year) or with altered pigmentation. Coloring or pigmentation of scars may be increased in patients with olive-colored skin and represents mostly a post- inflammatory response that will fade in 3–18 months. This requires sun protection. Reparative treatment may not always be required.

1.2. **Deep dermal scarring:** Includes icepick scars, rolling scars and boxcar scars. Ice-pick scars are frequently deeper, with sharp, steep sides. Rolling scars are caused by damage under the surface of the skin. They give the skin a wave-like appearance. They tend to be wide and shallow. Boxcar scars are angular scars with sharp vertical edges and are often found on cheeks and temples. They may be shallow or deep.

2. **Those involving tissue excess:**

2.1. **Hypertrophic scars:** Confined to the boundary of the original injury and increase in bulk by pushing out the margin. They are usually asymptomatic and develop within weeks after the injury and tend to resolve gradually. They tend to appear on the upper back, upper chest and deltoid region but can also appear on mandibular, malar and glabellar regions.

2.2**. Keloids:** They are irregularly shaped scars that extend beyond the borders of the original wound into adjacent tissue. They are often pruritic and tender. They are common in mandibular arch, shoulders and sternal region and are prone to recur.

2.3. **Bridge:** Bridge is a fibrous string over healthy skin. They are common on face.

2.4**. Papular scars:** They are soft elevations, like anetodermas and are frequently observed on the trunk and mental area.

Treatment for acne scarring by laser and its side effects

Acne scarring is permanent but can be treated. No treatment is 100% effective and the best result is improvement, not perfection. Treatment of scarring may require many different kinds of treatments, depending on the kind of scarring present. Treatment of acne scarring can be expensive and may not be covered by insurance. It is important that all the acne is clear before treating scarring. Many different treatments, including chemical peels, surgical excision, punch grafting, dermabrasion, and tissue augmentation with a variety of dermal fillers, have been used to improve atrophic acne scars with varying degrees of success.[3, 4]

Over the last decade, laser skin treatments for acne scarring have been primarily centered on laser resurfacing with carbon dioxide (CO2) and erbium- doped yttrium aluminum garnet (Er:YAG) lasers. Although these lasers have proven effective in improving scar appearance through collagen remodeling and skin recontouring, they have been associated with extended recovery periods, prolonged erythema, hypo and hyper pigmentation, and in rare cases, induction of additional scarring.[5,6] As a result of these potential risks and well-characterized adverse effects of ablative CO2 and Er:YAG laser resurfacing, non ablative laser technology using long- pulsed infrared (1,450-nm diode and 1,320-nm neodymium-doped yttrium aluminum garnet [Nd:YAG]) laser systems were developed as a safe alternative.[7]
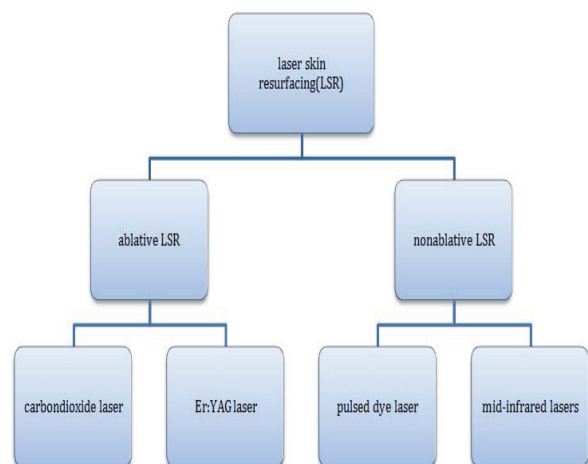

Figure 2: various options for laser treatment of acne scarring

1. **Ablative laser skin resurfacing**

1.1. Carbondioxide Laser

Skin resurfacing with the CO2 laser remains the gold standard technology for production of the most dramatic clinical and histologic improvement in severely photodamaged and scarred facial skin.[8] producing a wavelength of 10,600 nm, the $_{CO2}$ laser penetrates approximately 30 μm into the skin by absorption and vaporization of water-containing tissue. Older continuous-wave CO2 lasers produced an unacceptable amount of thermal destruction (up to 200 μm–2 mm beyond the target area).[9] The new generation of pulsed and scanned CO2 lasers limit this thermal damage by delivery of high energy laser light with tissue dwell times shorter than the

thermal relaxation time of the 30 μm of targeted tissue (about 1 ms). Use of the CO2 laser for skin resurfing yields an additional benefit of collagen tightening through heating of dermal collagen. The triple helical structure of collagen is altered, resulting in shortening of the fibers by one third.[10] Persistence of this collagen contraction results, in part, from these shortened fibers serving as a scaffold for neocollagenesis. Several CO2 laser systems are available and can be separated into two distinct groups: pulsed and scanned. CO2 laser has been used effectively to treat atrophic and other scars.[11,12] Sculpting of scars with the laser yields a more uniform skin texture and stimulates new collagen formation within the dermal defects. Patients can expect a mean improvement of 50–80% in moderate atrophic scars, with continued collagen remodeling and scar effacement for 12–18 months postoperatively.[11,12] Patients with scars previously treated with dermabrasion or deep chemical peels may have additional fibrosis, which is more difficult to vaporize, thereby reducing their potential outcome. In addition, these patients also may have concealed hypopigmentation that could become more apparent after laser skin resurfacing.[12,13] Although patients with paler skin tones are at lower risk for developing postoperative hyperpigmentation, those with darker skin tones can successfully undergo CO2 laser resurfacing.

1.2. Erbium: Yttrium-Aluminum-Garnet Laser

The emitted wavelength of 2,900 nm is absorbed 12–18 times more efficiently by superficial cutaneous tissues, and approximately 2–5 μm of ablation occurs per pass with equally narrow zones of thermal necrosis.[14] Clinically, this translates into a shorter postoperative healing time with much less post treatment erythema and risk of hyper pigmentation than CO2 lasers. However, immediate collagen contraction is only about 1–4%, and long-term collagen remodeling ranges from 0–14%.[8] Multiple passes with this laser are necessary to ablate to a similar depth as one pass of the CO2 laser, and because the Er:YAG effects are photomechanical instead of photothermal (like the CO2), intraoperative hemostasis is difficult to achieve.[8,15] Therefore, the short-pulsed Er:YAG laser is limited in its utility for moderate-to-severe acne scars. Hybrid Er:YAG/CO2 laser systems (e.g., Derma-K, Lumenis, Santa Clara, CA, USA) are capable of delivering both CO2 energy for coagulation and Er:YAG energy for fine tissue ablation. The dual mode Er:YAG (e.g., Contour, Sciton, Palo Alto, CA, USA) combines short pulses (for ablation) with longer pulses (for coagulation). The variable-pulsed Er:YAG (CO3, Cynosure, Chelms- ford, MA, USA) system has a range of pulse durations from 500 μs to 10

ms, with the longer pulses effecting coagulation and thermal injury similar to the CO2 laser.[16] As a group, these lasers have been shown to produce deeper tissue vaporization, greater control of hemostasis, and collagen contraction. This translates into greater clinical improvement in mild-to-moderate acne scars than their short-pulsed predecessors and thus represent a good compromise between CO2 and earlier generation Er:YAG laser.[17-21]

2. Adverse Effects and Complications of ablative LSR

Side effects and complications are varied and greatly influenced by postoperative care, patient selection, and operator skill. In general, the side-effect profile after Er:YAG laser resurfacing is similar but less severe and more transient when compared with those experienced after CO2 laser resurfacing table 1.[22-24]

Table 1: side effects and complications of ablative LSR

Side effects	Mild complications	Moderate complications	Severe complications
Transient erythema	Prolonged erythema	Pigmentary change	Hypertrophic scar
Localized edema	Milia	Infection (bacterial, viral, fungal)	Ectropion
Pruritus	Acne		Hypopigmentation
	Contact dermatitis		

Postoperative erythema, lasting an average of 4.5 months, is an expected occurrence in all CO2 laser treated patients and is a normal consequence of the wound healing process. Degree of erythema correlates directly with the depth of ablation and number of laser passes performed.[25,26] It may also be aggravated by underlying rosacea or dermatitis. Topical agents like retinoic acid derivatives, glycolic acid, fragrance or chemical containing cosmetics and sunscreens should be strictly avoided in early postoperative period until substantial healing has occurred.[25] Mild side effects includes milia formation and acne exacerbation, which may be caused by the postoperative use of occlusive dressings and ointments particularly in patients who are acne prone.[25-29] Milia and acne usually resolve spontaneously as healing progresses and application of thick emollient creams and occlusive ceases. Oral antibiotics may be prescribed for acne flares that do not respond to topical preparation.[25,29,30] Wound infections associated with ablative laser resurfacing include staphylococcus and pseudomonas infections and cutaneous

candidiasis and should be treated aggressively with an appropriate systemic antibiotic or antifungal agent.[31] The most common infectious complication is a reactivation of labial HSV infection.[25,27] Therefore all patients undergoing full-face or perioral ablative resurfacing should receive antiviral prophylaxis even if they report no history of HSV infection. Patients should begin prophylaxis by the day of surgery and continue it for 7 to 10 days postoperatively.[32] Hyperpigmentation is one of the more common side effects and occurs to some degree in all patients with darker skin tones.[31,33] The reaction is transient but its resolution can be hastened with use of topical agents like hydroquinone and retinoic, azelaic, kojic, and glycolic acid. Hypopigmentation is particularly intractable to treatment. The use of an eximer laser or topical photochemotherapy to stimulate repigmentation has proven successful in some patients.[34,35] The most severe complications includes hypertrophic scars and ectropion formation.[33,36] Focal areas of bright erythema with pruritus, particularly along the mandible, may signal impending scar formation.[32,37] Potent topical corticosteroid preparations should be applied to decrease inflammatory response. A pulsed dye laser can also be used to improve the appearance and symptoms of laser induced burn scars.[38] Ectropion of lower eyelid is rarely seen but, if encountered, usually requires surgical correction.[28] In general, lower fluences and fewer laser passes should be applied in the periorbital area to decrease the risk of lid eversion.

Side effects and complications after Er:YAG laser resurfacing are similar to those observed after CO2 laser skin resurfacing but they differ in duration, incidence, and severity .[39,40]

3. Nonablative laser skin resurfacing

While ablative skin resurfacing with CO2 and Er:YAG lasers has been proven highly efficacious in reversing the signs of atrophic scars, the associated lifestyle hindrance and potential complications are often unacceptable to patients. In recent years, focus has shifted towards nonablative technologies that deliver either laser, light based, or radiofrequency energies to the skin.

3.1. Pulsed Dye Laser

Used predominantly for the treatment of hypertrophic scars.[41,42] The most common side effects include mild edema, purpura, and transient post inflammatory hyperpigmentation. It has been hypothesized that the selective heating of dermal vessels leads to release of endothelial-derived growth factors and cytokines that up-regulate fibroblasts in treated skin, thereby resulting in neocollagenesis.

3.2. Mid-infrared lasers

Laser systems operating in the mid infrared portion of the electromagnetic spectrum, including the 1320 nm Nd:YAG, 1450 nm diode, and 1540 Er:Glass lasers, possess optimal wave lengths for water-based non-ablative skin re-modeling.[43] The majority of ultraviolet induced sun damage occurs at dermal depths of 100–400 um and, because the water absorption coefficient is low at wavelengths longer than 700 nm, infrared lasers (>1000 nm) are able to better deliver energy at these tissue depths.[44]

To protect the epidermis, dynamic cooling is employed. The hand piece contains a thermal sensor to assist in maintaining the epidermal temperature below 50°C. At 40–45°C, the dermis is heated to a temperature reached of 60–65°.[44, 45] The latest generation of the 1320nm Nd:YAG laser (Cool Touch II, ICN Pharmaceuticals, Costa Mesa, CA) delivers energies ranging 28–38 J/cm2 with a pulse duration of 350 *us* through a 10 mm spot size hand- piece. Treatments are usually performed every month for a series of at least three sessions. Multiple studies have shown efficacy in the treatment of atrophic facial scars with only mild edema and erythema post-procedure.[45,46] A study comparing the 1320 nm Nd:YAG to the 1450 nm diode laser for treatment of atrophic acne scars revealed that the 1450 nm laser effected more significant change in the scar appearance and skin texture.[46] Both mid-infrared lasers, however, induced clinical improvement. With the additional positive effect of the 1450 nm diode laser on active acneiform lesions,[47] this system may be preferable for those patients with concomitant acne and atrophic facial scars.

4. Side effects and complications of non ablative lasers.-Ablative Lasers/ R

Side effects of non-ablative laser treatments are generally mild and transient. Local erythema and edema are typically observed in treated skin; however, a small percentage of patients in these studies experience superficial burns, ecchymoses, dysesthesias, and vesiculation.[48, 49-52] In some cases, post treatment hyperpigmentation has been caused by excessive use of cryogen spray but has resolved with topical bleaching agents. To avoid reactivation of latent HSV infections, appropriate oral antiviral prophylaxis should be considered for all patients regardless of reported HSV status.

Conclusion:

Laser treatment has revolutionized the approach to acne

scarring but it has yet a long way to go in order to get more satisfying results in short time. The Results after treatment will disappoint patients who desire dramatic improvement in a short period of time. Additionally, although these technologies have a much lower side effect profile, they are not devoid of risks. Ultimate goal of any intervention in acne scarring is not total cure or perfection; rather it is making scars less visible. Selection of appropriate technique requires that patient factors as well as the risks and benefits of the procedure be weighed.

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