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REVIEW ARTICLE

Energy-based devices in the treatment of acne scars in skin of color

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Abstract

Background: Acne scarring is disfiguring and psychologically taxing on patients. Many energy-based modalities have emerged and been studied for the treatment of acne scarring; however, there is a paucity of these studies in skin phototypes IV–VI.

Objective: To review the medical literature and discuss the most significant studies regarding safety and efficacy of energy-based devices (ablative lasers, non-ablative lasers, and radiofrequency microneedling) in the treatment of ethnic skin (skin phototypes IV–VI).

Methods: A literature search was conducted using the PubMed database and bibliographies of relevant articles.

Results: Ablative and non-ablative lasers have proven to be effective for treatment of acne scars in ethnic skin. The risk of developing adverse effects such as post-inflammatory hyperpigmentation is contingent upon several factors including skin phototype, laser device, fluence, and moreso density settings. Non-ablative fractional lasers have been considered first line for the treatment of acne scars in skin of color due to their better safety profile; however, they are less efficacious and require more treatments compared to ablative lasers. Studies regarding efficacy and safety of radiofrequency microneedling for treatment of acne scarring in skin of color are limited, but are promising.

Conclusion: Ablative lasers, non-ablative lasers, and radiofrequency microneedling are all useful treatments for acne scarring in ethnic skin when appropriate settings are used. Further head-to-head studies are needed to evaluate their efficacy and safety in darker skin phototypes V–VI.

KEYWORDS
ablative laser, acne scarring, non-ablative laser, radiofrequency microneedling, skin of color

1 | INTRODUCTION

Acne vulgaris is a chronic inflammatory skin condition caused by the blockage of sebaceous glands and colonization of *Propionibacterium acnes*.[1] While acne affects hundreds of thousands of individuals physically, it has been shown to increase one's risk of psychological disturbances including depression, anxiety, and low self-esteem.[2] One longitudinal study reported that even after 15 years, the probability of developing major depressive disorder among acne patients was 18.5%.[2] While several treatment options are available including

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topical agents, antibiotics, and isotretinoin, acne is a chronic disease and early intervention is critical in reducing the risk of scarring and hyperpigmentation.[1]

Lasers have become increasingly popular in the management of acne and even more so in treating the residual acne scarring and hyperpigmentation.[3] Non-ablative lasers are resurfacing lasers that work through fractional photothermolysis in which thousands of microscopic thermal zones are created in the skin while sparing the epidermis.[3] The areas targeted by non-ablative lasers are thermally injured to deliver energy deep within the dermis to stimulate collagenolysis and neocollagenesis.[3] On the contrary, ablative lasers work by removing the epidermis and delivering energy deep into the dermis which stimulates neocollagenesis. This has traditionally been considered a more aggressive form of treatment with prolonged downtime and high rate of adverse events.[4] Similarly, it has been regarded as high risk in patients of color.[4] Both ablative and non-ablative lasers have been well studied and proven to significantly improve the appearance of acne scarring and hyperpigmentation.[4]

Acne and acne scarring affect all races; however, there is a disparity of literature between treatments for acne scarring in skin of color patients. More specifically, many practitioners are reluctant to treat acne scarring in patients of color with laser energy devices due to higher risk of hyperpigmentation and worsening scarring compared to lighter skinned patients.[4] This article will serve as a recent update on the efficacy of both non-ablative and ablative lasers in the treatment of acne scarring in skin of color patients, as well as radiofrequency and microneedling devices. By increasing awareness of the efficacy and safety of treating acne scars in skin of color, we hope to increase the armamentarium of treatment options for this patient population.

2 | METHODS

In order to study both the efficacy and potential risks associated with treating acne scarring in patients of color with both non-ablative and ablative lasers, we conducted a PubMed search using keywords (individually and in combination) including "ablative lasers," "non ablative laser," "acne scar laser," "radiofrequency microneedling", "ethnic skin," "skin of color," and "darker skin." Of the 700+ papers that were reviewed, 29 articles were selected from the time frame 2011 to 2021, 19 of which are summarized in Tables 1–3. Articles were selected depending on their relevance to acne scarring management with lasers on specifically patients of Fitzpatrick skin types IV–VI. The studies excluded from this review were any studies with combination treatments other than ablative lasers, non-ablative lasers, and radiofrequency microneedling including topicals, PRP, microneedling and light-based energy devices, studies not including Fitzpatrick skin types IV–VI or limiting their patient population to only skin types I–III, literature review articles, case reports, posters, letters, studies not written in English, and studies treating anything other than acne scarring.

3 | ABLATIVE LASERS

Ablative resurfacing lasers, such as CO_2 and Er:YAG, are considered to be the most effective treatment modalities for improvement of acne scars; however, risk of unwanted side effects limit their use in ethnic skin. Table 1 depicts relevant details of recent literature covering outcomes and safety of ablative lasers in skin phototypes (SPTs) IV–VI. During this literature review, most of the studies obtained covered SPTs IV in Asian skin; therefore, more studies including SPTs V–VI are needed.

Traditional Er:YAG lasers (2940 nm) are highly selective for water, which results in superficial ablation with less underlying thermal damage. In contrast, CO_2 lasers have a lower selectivity for water and penetrate deeper, resulting in additional thermal damage and coagulation of the surrounding tissue. Although the more aggressive properties of CO_2 lasers allow for better collagen remodeling and tissue contraction, it also has higher risk of adverse effects, prompting caution of its use in patients prone to scarring and hyperpigmentation.[5]

Fractional CO_2 reduces the density of ablation which allows for improvement in skin rejuvenation and scarring with shorter recovery periods and a reduced side effect profile compared to traditional laser resurfacing. This is due to residual islands of normal skin which serve as a stem cell reservoir for healing. While safer than purely ablative treatment, fractional treatment continues to ablate the dermal-epidermal junction maintaining the risk of pigmentary abnormalities. Data regarding the effectiveness and safety of fractional CO_2 laser treatment in Fitzpatrick skin types IV–VI are lacking. Ochi et al.[6] conducted a retrospective study looking at the efficacy and complication rates of facial acne scars treated with fractional CO_2 laser in the Asian patients. Fifteen percent of patients had adverse effects with the most common being hyperpigmentation (6.4%) followed by blistering (4.0%). Fractional laser treatment settings, most notably both fluence and treatment density, can impact the extent of dermal-epidermal junction disruption which can influence the occurrence of PIH. Earlier reports have shown that a higher treatment density was associated with a greater degree of PIH.[6,7]

In Alajlan et al.'s[8] retrospective analysis, it is mentioned that higher rates of adverse reactions were observed with higher fluences in SPTs IV and V with fractional CO_2 laser. Therefore in these skin types, it is recommended to reserve higher fluences of 125–175 mJ/cm^2 with 30%–40% coverage for moderate to severe acne scars in SPTs IV–VI and mid fluence 125 mJ/cm^2 with 20%–30% coverage in mild acne scars in this patient population. If the patient has a previous history of melasma or other facial pigmentations, lower fluences of 60 mJ/cm^2 with 10% coverage for 2–6 sessions are recommended depending on acne scar severity.[8] Majid and Imran.[9] found that with fractional CO_2 laser monotherapy (fluence 15–25 J/cm^2, density 100–150 MTZ/cm^2, and energy 40–45 mJ), rolling and superficial boxcar scars responded the best while ice pick pitted scars responded the least. This finding has therapeutic importance as patients with predominantly pitted or ice-pick scarring will likely require additional modalities of treatment.

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TABLE 1 Ablative lasers for acne scar resurfacing in SPT IV–VI

Author, year	Skin types	SPT (IV, V, VI)	Treatment modality	Adverse effects (AEs)
Lee et al., 2014[9]	III–IV	16, 5, 9	Dual-mode Er:YAG laser. Settings: 70 μm of ablation (17.5 J/cm^2) with 50% spot overlap (spot size of 4 mm) and 70 μm of coagulation.	Erythema lasting >3 months: 9.1% PIH: 45.5% (lasted >3 months in 4.5%). Mild hypopigmentation: 4.5%. Acne flare: 22.7.
Majid and Imran, 2014[7]	II–IV	18, 0, 0	Fractional CO_2. Settings: Fluence: 15–25 J/cm^2. Density: 100–150 MTZ/cm^2. Energy: 40–45 mJ of energy. Ablation depth: 1–1.2 mm. Session every 6 weeks, total of 3–4 sessions.	PIH observed in three patients (resolved over 2–3 months with topical therapy).
Ochi et al., 2017[4]	II–IV	103, 5, 0	Fractional CO_2. Settings: Laser spot sizes: 180 or 300 μm. Fluence: 8–25 J/cm^2. Index settings (dwell time): 5–10. Density: 20%.	15% total experienced AEs: hyperpigmentation (6.4%), blistering (4%), crusting (2.9%), aggravation of inflammatory acne lesions (1.7%), and scarring (0.6%).
Chathra and Mysore, 2018[3]	IV–V	49, 31, 0	Variable square pulse (VSP) Er:YAG laser.	Prolonged erythema (lasting >4 days) was seen two patients (2.5%) Crusting (lasting 10 days) and hyperpigmentation (lasting 1 month) in one patient each (1.25%).
Cenk and Sarac, 2020[30]	II–IV	5, 0, 0	2940 nm multifractional Er:YAG laser. Settings: 300 μs, 40 J/cm^2, 4 Hz with 0.35 mm spot size in E25 mode. Three sessions repeated 4 weeks apart with 10-joule increases, up to a maximum does of 70 J/cm^2.	PIH only observed in one patient with SPT II skin (none in other SPTs).
Chen et al., 2021[10]	III–IV	Not specified	2940 nm Er:YAG laser in three different modes: 1. Microlaserpeeling mode (MM)—60 μm, 20% repetition rate. 2. Fractional ablative mode (FM)—300 μm, 8% fractional density. 3. 3. Combined mode (CM)—200 μm, 8% fractional density, 20% repetition rate.	PIH: Statistical difference among the three groups ($p < 0.05$), FM group had the lightest pigmentation, while the CM group had the heaviest.

There are some studies in Asian skin types III and IV that show fractional CO_2 lasers are a safe and effective treatment for acne scarring.[6] To our knowledge, there is no published literature on fractional CO_2 lasers in SPT VI. Therefore, this device should be used with caution in this patient population, and a high risk for hyperpigmentation should be considered. In our personal experience, low density settings should always be a starting point for patients with pigmented skin with a test spot on lateral preauricular skin for assessment.

The Er:YAG laser, like CO_2, has ablative and fractional ablative properties. Because depth can be controlled by most devices, it is often more precise without the intrinsic thermal ablation. The effects of three different modes of Er:YAG laser (microlaser peel [ablative] vs. fractional ablative vs. combined mode) in the treatment of facial acne scars in SPT III–IV were studied by Chen et al.[10] In this randomized control study, they divided patients into three groups. One group received the microlaser peeling mode with a depth of 60 mm and a repetition rate of 20%. The fractional ablative mode was performed with a depth of 300 mm and a fractional density of 8%. The combined mode group received a fractional depth of 200 mm, density of 8%, peeling depth of 30 mm, and repetition rate of 20%. The improvement of acne scarring in all three modes was found to be statistically significant. Combined mode was found to have the greatest efficacy; however, it was also associated with more severe complications such as PIH and pain ($p < 0.05$). Fractional ablative mode was the second most effective and associated with the lowest rate of adverse effects, making it the safest choice for patients of color.

As previously mentioned, although Er:YAG laser has more precise depth and less aggressive thermal effects it is considered to be less effective in stimulating collagen contraction, intraoperative hemostasis, and coagulation. Newer lasers have been created to combine the accuracy of short-pulsed Er:YAG with the controlled thermal effects of CO_2 in attempts to address the limitations of conventional Er:YAG resurfacing.[11]

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TABLE 2 Non-ablative lasers for acne scar resurfacing in SPT IV–VI

Authors, year	Skin types	SPT (IV, V, VI)	Treatment modality	Adverse effects (AEs)
Rongsaard and Rummaneethorn, 2014[13]	III–V	2, 3, 0	Split face: One side 1550 nm Er:Glass fractional laser and other side fractional bipolar radiofrequency (RF).	Fractional laser: 5% PIH. RF: No PIH.
Brauer et al., 2015[18]	I–V	3, 0, 0	755-nm Alexandrite picosecond pulse duration laser with diffractive lens array (DLA). Six treatments, 6 mm spot size, 0.71 J/cm^2, 5 Hz repetition rate, 750 picosecond pulse width with DLA.	Not mentioned.
Alexis et al., 2016[12]	IV–VI	3, 4, 2	1550 nm fractional laser split face: same fluence 40 mJ, different densities: 200 versus 393 MTZ/cm^2.	Lower density: 43% PIH. Higher density: 71% PIH.
Cachafeiro et al., 2016[31]	II–V	10, 0, 0	Non-ablative fractional (NAF) erbium laser 1340 nm versus microneedling.	Fractional laser: 13.6% PIH. Microneedling: No PIH.
Haimovic et al., 2016[17]	IV–VI	35, 12, 9	755-nm picosecond laser with diffractive lens array (DLA).	All transient (Most commonly PIH and erythema).
Kwon et al., 2020[15]	III–IV	12, 13, 0	Split face: 1064 nm nd:YAG picosecond laser on one side and non-ablative 1550 nm erbium-glass fractional laser on other side.	Mild PIH: four patients.
Wang et al., 2020[32]	III–IV	8, 0, 0	1440-nm NAF laser system. Total of eight passes. Laser parameters were limited to high gear (390 μm depth, 4.5% coverage, energy of 9 mJ).	None.
Manuskiatti et al., 2021[14]	III–IV	11, 15, 0	1064-nm picosecond laser (spot size of 8 mm, fluence of 1.0 J/cm^2, a repetition rate of 10 Hz) in combination with the MLA handpiece for an average of three passes, for 6 monthly sessions.	Mild PIH (18%). Temporary, resolved in 4 weeks.
Shi et al., 2021[16]	IV	22, 0, 0	Split face: Fractionated frequency-doubled 1064/532 nm picosecond Nd:YAG laser one side and Fractional 1540 nm Er:glass.	Erythema rate was higher in picosecond laser. Edema, exudation, purpura, pain, and long-term AEs were similar between the groups.

The Er:YAG laser has a new modified system with variable square pulse technology (VSP) that claims to have superior efficacy to its traditional form. VSP technology alters pulse width and energy simultaneously which allows for strict control of the degree of ablation and deep tissue heating, minimizing excess laser energy absorption into surrounding skin. This results in less energy being needlessly transferred to body tissues and converted into heat, therefore there is a lower risk of adverse effects and increased efficacy. Due to its superior tissue dynamics, the variable-pulsed Er:YAG laser provides promise of improved safety and efficacy compared to traditional Er:YAG.[5] Chathra and Mysore[5] conducted a retrospective study looking at the efficacy and safety of the new variable square pulse (VSP) Er:YAG laser as a modality for treating facial acne scars in Fitzpatrick skin types IV and V. In order to stimulate collagen production at the depressed central portion of the scars, fractional mode at medium laser pulse and long pulse was used. To ablate raised scar borders and hypertrophic scars, a non-fractionated short laser pulse was employed. Ninety-seven percent of patients achieved at least a fair improvement of acne scarring. Only one out of 80 subjects developed post-inflammatory hyperpigmentation. Through a combination of ablative and fractional mode settings, the Er:YAG laser with variable pulse technology has proven to be safe and effective for treatment of acne scars in darker skin types. However, in order to determine the ideal laser parameters for optimal outcomes in skin of color, further studies focusing on ethnic skin need to be conducted.

4 | NON-ABLATIVE LASERS

Non-ablative lasers are popularly used to treat acne scars and have become the preferred treatment option due to reduced downtime and greater tolerability.[3] Similar to ablative systems, this modality induces collagen remodeling in the dermis via thermal induction by targeting water as its chromophore.[3] In contrast to ablative, non-ablative lasers do not vaporize the overlying epidermis; therefore, they have less downtime and adverse reactions.[8] However, due to its

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TABLE 3 Ablative versus non-ablative lasers for acne scar resurfacing in SPT IV–VI

Authors, year	Skin types	SPT (IV, V, VI)	Treatment modality	Adverse effects (AEs)
Cheng et al., 2021[33]	III–V	17, 1, 0	Split-face: 1565-nm Er:Glass non-ablative fractional laser and 10 600-nm ablative fractional laser (AFL)	Two cases (10.52%) of PIH and one case (5.26%) of transient acneiform eruption with 10 600-nm AFL treatment.
Sirithanabadeekul et al., 2021[34]	III–V	7, 17, 1	Split-face: Fractional picosecond 1064-nm laser and fractional CO_2 laser	Mild PIH: Fractional picosecond 1064-nm: 0%. Fractional CO_2: 24%.
Alajlan et al., 2011[8]	III–V	Not specified	Non-ablative fractional (NAF) 1550-nm and ablative fractional (AF) 10 600-nm CO_2 laser	PIH: 17% NAF laser, 14% AF laser. Hypopigmentation: 0% NAF laser, 2.7% AF laser. Herpetic infection: 4.4% NAF laser, 5.4% AF laser. Acneform eruption: 22% NAF laser, 16% AF laser.
You et al., 2016[35]	IV	58, 0, 0	1. Resurfacing lasers A 10 600-nm ultrapulse CO_2 laser B 2940-nm Er:YAG laser 2. Fractional lasers A 1550-nm erbium-doped fiber NAF laser B 10 600-nm CO_2 AF laser	PIH: Ablative lasers: CO_2—80%, ErYAG—60%. Fractional lasers: AF—20% NAF—10%.

less aggressive nature, non-ablative lasers require multiple sessions to achieve the same efficacy as ablative lasers when treating more severe forms of acne scarring.

Although non-ablative laser resurfacing is known to have less side effects and shorter recovery times, there are still safety concerns related to their use in ethnic skin. The efficacy and side effect profile of these lasers for treatment of acne scarring in lighter-skinned patients is well-known due to the vast amount of studies conducted in these individuals. However, there is limited literature published on SPTs IV–VI. Table 2 summarizes recent literature of non-ablative lasers for treatment of acne scars in SPTs IV–VI. After reviewing the recent literature, non-ablative laser resurfacing is considered both safe and effective in treating acne scars in ethnic skin.

Non-ablative fractional resurfacing with an erbium-doped glass 1550 nm laser has been studied in patients with SPT IV–VI and has shown to be efficacious and low-risk in treating acne scars.[12,13] Alexis et al.[12] conducted a split face study comparing the outcomes of higher (393 MTZ/cm^2) versus lower (220 MTZ/cm^2) treatment densities on facial acne scars with a constant fluence of 40 mJ using a 1550 nm erbium-doped fractionated non-ablative laser. Although the study group was small, there was no statistically significant difference in efficacy and risk of PIH between lower and higher density groups. Therefore, non-ablative 1550 nm fractional laser was found to be a safe and effective treatment option for acne scarring in SPTs IV–VI in this study. Rongsaard and Rummaneethorn[13] used similar energy settings with the fractional erbium-doped glass 1550 nm laser in a split-faced study comparing it to fractional bipolar radiofrequency for the treatment of facial acne scars in SPTs III–V. Both showed significant improvement in acne scarring, but the 1550 nm laser was superior in recovery time as it had a shorter duration of scab shedding. One of the 20 patients treated with 1550 nm laser developed PIH, but it was mild and transient.[13] Alajlan et al.[8] conducted a retrospective analysis of facial acne scar treatment with fractional 1550 nm laser versus fractional CO_2 laser in dark-skinned individuals. Fortunately, although the parameters of NAF laser 1550 nm were similar to those used in light-skinned patients, there were lower than expected rates of adverse events (17% rate of PIH). Laser settings with higher fluences were found to have a higher incidence of PIH, especially in SPTs IV and V. Therefore, when treating SPTs IV-VI, higher fluences (3–4 KJ/session 4–6 treatments) should be reserved for moderate to severe acne scars in patients with no history of melasma. If there is a history of melasma or PIH, lower fluences of 1–2 KJ/session should be used for up to 6-8 sessions depending on severity of scarring.[8]

Fractional lasers have been commonly utilized in the treatment of acne scarring, but recent technological advancements regarding picosecond pulse duration with diffractive lens array also show promising results. Picosecond lasers work by producing an ultrashort, picosecond pulse duration to induce photomechanical effects on its target. The innovative use of picosecond lasers in conjunction with a diffractive optical element allows for the redistribution of the laser beam into areas of high fluence surrounded by a lower fluence background, thereby producing a grid of focused, microinjury zones.[14] Recent studies have supported the efficacy of fractional picosecond lasers in the treatment of atrophic acne scars.[14] The induction of microinjury zones stimulates dermal remodeling and wound repair which ultimately improves skin texture and the appearance of atrophic scarring.[14] Picosecond lasers may provide better clinical outcomes and safety profile for acne scarring in skin of color because, in contrast to fractionated photothermolysis, they do not damage the epidermis and dermal-epidermal junction.[15] Due to the fact that the dermal-epidermal

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junction is not compromised, we are categorizing these lasers as non-ablative in this paper.

Despite fractional lasers being first-line treatment for atrophic acne scarring, recent studies have shown picosecond lasers using diffractive optical elements (P-DOE) to be a promising alternative.[14–18] Manuskiatti et al.[14] performed the first prospective study to evaluate the efficacy and safety of a 1064 nm picosecond laser with fractionated MLA in the treatment of atrophic facial acne scars in Asians. They reported at least 50% improvement of scarring at 6 month follow-up with a transient PIH rate of 18%.[14] Not only does P-DOE provide great efficacy through its stimulation of dermal remodeling, but its ability to circumvent collateral thermal damage provides a treatment option with lower risk of complications in ethnic skin compared to fractional photothermolysis-based devices. In a prospective, randomized, split-faced, controlled trial, Kwon et al.[15] compared a 1064 nm ND:YAG picosecond laser using a DOE to a non-ablative 1550 nm erbium-glass laser for the treatment of facial acne scarring in Asian patients. Acne scar appearance was significantly improved in the P-DOE treated side with less reported pain and adverse effects when compared to the non-ablative 1550 nm erbium glass treated side ($p < 0.05$). Haimovic et al.[17] performed a retrospective study looking at the safety of a 755 nm picosecond laser with DLA in Fitzpatrick skin types IV–VI. Parameters used included a spot size of 6 mm, fluence of 0.71 J/cm^2, and pulse width of 750–850 picoseconds. The most common adverse effects were erythema and hyperpigmentation, all of which fully resolved. These picosecond laser studies have shown promising results in Asian skin, but studies looking at darker skin types V and VI are lacking.

5 | RADIOFREQUENCY MICRONEEDLING

Radiofrequency microneedling (RF) is a form of controlled skin injury that passes a current through the dermis at a predetermined needle length creating small thermal wounds to stimulate dermal remodeling and the production of new collagen fibers.[19] This technology causes neocollagenogenesis by stimulating the release of growth factors with minimal disruption to the epidermis.[20]

While RF microneedling has been used to cauterize tissues and vessels, destroy tumors, and tighten pharyngeal tissues in sleep apnea, recent research has focused on the use of RF as an alternative to conventional methods of acne scar treatment.[21] RF targets acne scarring by mechanically disturbing the dermal fibrotic strands that contribute to skin retraction of atrophic scars and by stimulating collagen synthesis to replace fibrotic scar tissue with healthy, pliable collagen.[19] Over the course of multiple treatments, RF microneedling will soften scar defects and make acne scarring appear less noticeable.

Radiofrequency treatments offer a great advantage over lasers for darker skin types as they offer deeper treatment levels without the risk of hyperpigmentation and have minimal downtime.[22] This is because they allow for adjustment of needle depth which create uniform punctures at controlled depths with less epidermal damage and risk of dyspigmentation. Another advantage of RF is its ability to create specific thermal zones where channels are created for RF energy to reach the deeper skin layers with minimal energy dispersed in the epidermis. A study of 14 men and 5 women with skin types III–V were treated with a series of 3 sessions of non-ablative RF microneedling to treat facial acne scarring.[23] Researchers found significant improvement in 12%, moderate in 58%, and minimal in 29% with PIH occurring in only 1 patient that resolved in 4 weeks.[23] Chandrashekar et al.[20] conducted a study evaluating 31 patients with moderate to severe facial acne scarring of SPTs III–V treated with 4 fractional radiofrequency treatments spaced 6 weeks apart over a 6 month span. 80.64% of patients showed an improvement by 2 grades and 19.35% showed an improvement by 1 grade. Adverse effects were limited to transient pain, erythema, edema, and post-inflammatory hyperpigmentation which resolved in 3–5 days.[20]

Despite the differences between RF microneedling and more conventional lasers, RF can be used as monotherapy or as an adjuvant therapy with lasers when treating acne scarring. Simmons et al.[19] showed that pretreatment with a non-ablative laser lowers the skin's resistance to current flow and allows deeper penetration of the radiofrequencies, decreased level of discomfort, and reduced amount of RF energy needed to reach the optimal thermal dose.[19] Ultimately, the use of a non-ablative laser prior to RF microneedling can decrease the collateral effects to the surrounding dermis and decrease the chance of blistering, burns or inflammatory nodules.[19]

Radiofrequency microneedling has opened the door to a more inclusive approach to treating acne scarring in patients of all skin types. With minimal downtime, smaller number of required treatment sessions, less pain, and more precise delivery of energy, RF microneedling has the potential to be the mainstay of treatment for acne scarring in skin of color. While the results appear promising, further studies are needed in ethnic skin compared to conventional treatments of acne scarring.

6 | INNOVATION IN PREVENTION

Although all of these modalities are effective and safe in the treatment of acne scars in ethnic skin, due to this population's higher rates of significant sequelae of persistent acne such as post-inflammatory hyperpigmentation and scarring, prevention is key. While there are many topical and systemic treatments for inflammatory acne, adverse reactions and lack of compliance continue to be barriers in their efficacy. The use of lasers in the treatment of active acne has continued to gain popularity as it requires minimal patient compliance outside of the office and has lower risk of side effects. Infrared lasers have longer wavelengths causing lower amounts of absorption by melanin and little damage to the epidermis, making them safer in darker skin types. Various infrared lasers have been used in the treatment of active acne including the 1550 nm erbium glass, 1064 nm Nd:YAG, and 1320 nm Nd:YAG

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lasers.[24] They work by targeting the sebaceous gland and its associated hair follicle, causing thermal coagulation and decreased sebum production.[25] The absorption maxima of sebum has been shown to be around 1728 nm.[26,27] Due to the fact that, in addition to sebum, these infrared lasers also target water, hemoglobin, and melanin, they are somewhat limited in their potential for achieving maximal results in acne treatment. Most recently, an infrared Indium Phosphide (InP) diode laser with a wavelength of 1726 nm has been developed to selectively target sebaceous glands and decrease sebum production in patients with inflammatory acne. By selectively targeting sebum, this InP diode laser causes preferential thermal coagulation of sebaceous glands without damaging the overlying epidermis. Clinical trials showed that inflammatory lesion counts were reduced by a mean of 49.5% ± 26.5% from baseline. Of the 104 subjects studied, 79.8% had achieved treatment success at the 12-week follow-up visit, which is defined as ≥50% fewer inflammatory acne lesions 12 weeks after their final treatment visit than at baseline. This sustained reduction 12 weeks after last treatment suggests durability of treatment results. The most common reported adverse events were erythema and edema which were all mild and transient. There were no reports of blistering, dyspigmentation, or scarring in any subjects. While this has shown to have preliminary benefit in treating acne in skin of color, it has also been shown to be a promising treatment option for acne scarring in darker skin types. A multicenter study using a novel 1726 nm laser for treatment of facial acne scarring was presented at the American Society for Laser Medicine and Surgery conference in April of 2022 by Dr. Jeffrey Dover where 51.3% of patients were Fitzpatrick skin types IV–VI. Patients underwent three treatments of a 1726 nm laser with assessment of facial acne scarring 3 months after their final treatment session. 95% of the patients showed improvement in acne scarring with no serious adverse events.[28] Laser devices in the treatment of acne vulgaris and scarring offer some advantages over conventional treatment such as absence of compliance issues, medication interactions, and adverse effects associated with systemic medications.[29] Although further studies are necessary, the development of a device with a wavelength specific to the absorption peak of sebum is a promising addition to the treatment armamentarium for active acne vulgaris and acne scarring.

7 | CONCLUSION

Ablative and non-ablative lasers have proven to be effective for treatment of acne scars in ethnic skin. The risk of developing adverse effects such as post-inflammatory hyperpigmentation is contingent upon several factors including SPT, laser device, fluence, and moreso density settings. Non-ablative fractional lasers have been considered first line for the treatment of acne scars in skin of color due to their better safety profile; however, they are less efficacious and require more treatments compared to ablative lasers. Newer studies looking at P-DOE technology and variable-pulsed Er:YAG provide promising results to broaden the variety of limited treatment options available for acne scarring in darker skin types. In our experience, in a vacuum of laser technology, non-ablative and picosecond MLA/DOE are safe for all skin types with low fluence and low density. We reserve fractional ablative treatment in light to medium skin toned patients with no history of pigmentary anomalies with low density settings, regardless of fluence/depth. The biggest limitation of our review and literature is the lack of head to head or side by side studies in skin of color patients. However, new technology in the form of fractionated radiofrequency and radiofrequency with microneedling is slowly replacing laser treatment for an array of conditions in skin of color patients due to minimal risk of PIH.

CONFLICT OF INTEREST

Shereen Teymour, Barbara Kania: None. Karan Lal: No relevant conflicts of interest. Non-relevant conflicts of interest include: ADBOARD: Revision skincare, Clubderm, HCP live. Received travel funding: La Roche Posay. Paid blog post: Versed skincare. David Goldberg: No relevant conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available in PubMed at https://pubmed.ncbi.nlm.nih.gov/.

ETHICAL APPROVAL

Authors declare human ethics approval was not needed for this study.

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