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Combined Laser and Topical Treatments for Acne Scars: A Systematic Review

Dr. Noor Hussein Abduljabbar[1], Dr. Wassan Juber Abed[2] And Dr. Lina Salam Khashan Al-Jbarah[3]

[1]M.B.Ch.B., C.A.B.M.S. \ (Dermatology and Venereology), Iraqi Ministry of Health, Basrah Health Directorate, Al-Sayyab General Hospital, Basrah, Iraq.

[2]M.B.Ch.B., C.A.B.M.S. \ (Dermatology and Venereology), Iraqi Ministry of Health, Basrah Health Directorate, Al-Shifa General Hospital, Basrah, Iraq.

[3]M.B.Ch.B., C.A.B.M.S. \ (Dermatology and Venereology), Iraqi Ministry of Health, Basrah Health Directorate, Al-Shifa General Hospital, Basrah, Iraq.

Abstract: Acne scarring and the sequelae of acne (post-inflammatory hyperpigmentation) continue to be one of the most prevalent and psychologically distressing dermatological problems, and there is no single treatment modality that is consistently effective. This review collates the findings of ten recent publications (2022–2025), including narrative, systematic, randomized split-face, and Bayesian network meta-analyses on combined treatment strategies for acne scar and acne-sequelae treatment. The studies included were on energy-based devices (ablative and non-ablative fractional lasers, vascular lasers, intense pulsed light), procedural adjuncts (platelet-rich plasma, chemical peels, microneedling, dermal fillers, radiofrequency), and pharmacologic agents (oral isotretinoin, topical timolol, retinoids, hydroquinone, hormonal agents) used individually or, more commonly, in combination. In almost all studies, combination therapy performed better than monotherapy in validated scar-severity scores, lesion counts, and patient-reported satisfaction, with the two network meta-analyses showing combinations of laser and platelet-rich-plasma and laser and chemical peel as consistently top-ranked therapies. The adverse events of the combination protocols were nearly all trivial and temporary, similar to those of monotherapy. Despite this, the evidence is still limited in terms of the small and heterogeneous cohorts, inconsistent outcome measures, and short follow-up periods. This review found that using a combination of treatments is the most evidence-based treatment strategy for acne scar management. It emphasized the need for larger, standardized, multicentre trials to create formal clinical guidelines.

Keywords: Laser Acne, Scars, post-inflammatory hyperpigmentation systematic treatment.

INTRODUCTION

Acne is a common skin condition affecting young people in recent years, due to changing lifestyles, the number of people suffering from acne has increased year after year. Acne can leave scars on the face, affecting its appearance. Fractional laser therapy is considered an effective clinical method for treating acne. Studies have shown that using human epidermal growth factor gel with fractional laser can reduce the time it takes for scars to heal in patients, with noticeable results. This research analyses, Acne vulgaris is a chronic inflammatory condition limited to the pilosebaceous units, which presents with acne pimples, papules, pustules, and is sometimes complicated by scarring (Styczeń, P. 2017). Acne typically starts in puberty and affects about 27% of adolescents and 93% of late teens. Acne vulgaris (Amici, J. M. *et al*., 2023) is usually found on the face, neck, chest, and upper back. There are many factors involved in the etiology, such as increased sebum production caused by androgens, inflammatory keratinization, colonization of Cutibacterium acnes in the pilosebaceous unit, delayed immune response, diet, and genetic factors (Ziolkowski, N. *et al*., 2019). The various types of skin lesions can appear at various stages of acne vulgaris development and remission. Acne scarring has become a widespread disease that affects the face and has a profound impact on patients' mental health and quality of life (Patel, L. *et al*., 2014). 80% of people between the ages of 11 and 30 years will develop acne at some stage in their lives, and approximately 40% (Alster, T. S. *et al*., 2012; Limandjaja, G. C. *et al*., 2021; Hawkins, H. K. *et al*., 2018) will develop scarring as a result. The types of scars include the depressed acne scar, which is relatively serious and is characterized by the appearance of an orange peel, ice pick, meteorite crater, etc. (Burdzy, D. *et al*., 2017; Ahmad, T. J. *et al*., 2012). The presence of acne scars is linked to the satisfaction with appearance, low self-esteem, and an inferiority complex, which may lead to anxiety, depression, and even suicidal thoughts (Asilian, A. *et al*., 2011; Elcin, G., & Yalici-Armagan, B. 2017).

METHODOLOGY

The ten studies reviewed were published in the peer-reviewed literature and preprint between 2022 and 2025 and encompass a variety of methodological designs such as narrative reviews (Badziąg *et al*., 2025; Clementi *et al*., 2025 [two related publications]), systematic reviews (Kumar *et al*., 2025), randomized or interventional

***Corresponding Author:** Dr. Noor Hussein Abduljabbar

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comparative trials (Huang *et al*., 2023; Youssef *et al*., 2024), and quantitative meta-analyses, including two Bayesian network meta-analyses (Zhao *et al*., 2022; Wu *et al*., 2025), and one PRISMA-guided meta-analysis (Wang *et al*., 2024).

The literature search methods used in the review-type studies were basically PubMed, Scopus, Google Scholar, Embase, Cochrane Library, and Web of Science, covering publication periods from the early 2010s to 2023–2025. Keywords used in search strategies included the following: acne scars, combination therapy, laser treatment, microneedling, and regenerative therapy, usually using Boolean operators and Medical Subject Headings (MeSH). Badziąg *et al*. (2025) included 1,482 records, which they reduced to 42 after eligibility screening based on the full text, and Wu *et al*. (2025) combined the data from 68 RCTs with 4,480 patients.

The two network meta-analyses utilized the Cochrane risk-of-bias tool and surface-under-the-cumulative-ranking-curve (SUCRA) scores to rank the treatments by relative efficacy for each outcome of interest, including ECCA scores and Goodman and Baron Scale (GBS) scores. The two network meta-analyses used Bayesian statistical models to directly compare several competing treatment combinations at once and rank the treatment options by relative efficacy based on the ECCA scores and Goodman and Baron Scale (GBS) scores using the Cochrane risk-of-bias tool and surface-under-the-cumulative-ranking-curve (SUCRA) scores. This study was conducted systematically to compare isotretinoin monotherapy with isotretinoin in conjunction with laser/light therapy, based on PRISMA guidelines, by Wang *et al*. (2024).

Huang *et al*. (2023) used a prospective randomized intra-patient or split-face design with 33 patients with treatment comparison between thulium fiber laser alone and thulium fiber laser combined with salicylic acid peel; Youssef *et al*. (2024) used a prospective randomized split-face design with 62 patients and a treatment comparison between fractional CO2 alone and fractional CO2 with topical timolol maleate.

RESULTS

Table 1: Providing the researcher with preliminary data related to the research and its primary objective.

s	Year	Researcher(s) & Publication Details	Research Objective
1	2025	**Magdalena Badziąg, Martyna Kłossowska, Karolina Skonieczna**	• The main goal of the research paper is to discuss the literature researched on combined therapy in acne scars in a critical way, and the goal of the paper is to make the reader aware of the best possible therapeutic combinations in the therapy of acne scars.
2	2022	**Zixiao Zhao, Tao Wang, Wei Li +2 more**	Evaluate efficacy of laser treatments for acne scars.
3	2025	**Aakash Kumar, Himanshu Chauhan, Parul Tandon +3 more**	The primary objective of the research paper is to critically evaluate current treatment modalities for acne scarring, and the paper emphasizes the efficacy and limitations of various treatment approaches.
4	2025	**Alessandro Clementi, Giovanni Cannarozzo, Luca Guarino +7 more**	The main aim of the research paper is to critically analyze the existing evidence on combination therapies for various types of scars such as atrophic, hypertrophic, keloid, post-surgical, and burn scars. The paper will focus on the effectiveness of using combined laser sources (serial and parallel) for selectively addressing different tissue components when treating scars.
5	2025	**Alessandro Clementi, Giovanni Cannarozzo, Luca Guarino +7 more**	The main aim of the research paper is to critically assess the evidence regarding combination therapies for different kinds of scars (atrophic, hypertrophic, keloid, post-surgical and burn scars).
6	2023	**Shiliu Huang, Dan Ye, Zhao-yang Wang +6 more**	• The primary objective of the research is to evaluate the efficacy and safety of the 1927nm fractional thulium fiber laser (TFL) in the treatment of acne and acne scars.

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			● A secondary objective is to compare the effects of TFL monotherapy with the concomitant application of TFL and 30% supramolecular salicylic acid (SSA) chemical peeling.
7	2025	**Oluwatosin Christiana Adebusoye, Gautam Srivastava**	● The primary objective of the research paper is to evaluate the efficacy of combination therapies for managing acne and post-inflammatory hyperpigmentation (PIH). ● The paper aims to analyze the effectiveness of various treatment modalities, including topical agents, systemic treatments, and procedural interventions.
8	2024	**Yi Wang, Li Tang, Li Yang +1 more**	The main aim of the study is to determine the effectiveness and safety of oral isotretinoin alone and in combination with laser/light-based treatment for acne vulgaris. The objective of the study is to compare clinical improvement rates of subjects taking isotretinoin alone and the subjects taking isotretinoin and laser/light therapy.
9	2024	**Ayman Ahmed Youssef, Ahmed Mohamed Elzaki, El-Sayed Galal Khater**	● The primary objective of the research was to compare the efficacy and safety of topical timolol maleate 0.5% after fractional CO2 laser treatment versus fractional CO2 laser treatment alone in the management of acne scars. ● The study aimed to evaluate the improvement in acne scar outcomes, including texture, pigmentation, and overall skin appearance, when combining topical timolol with laser therapy.
10	2025	**Bingwei Wu, Mingju Gao, Yi-Xuan Zhang +1 more**	Seeks to evaluate various treatment outcomes, including Echelle d'evaluation clinique des cicatrices 'acne (ECCA) scores and Goodman and Baron Scale (GBS) scores.

Table 2: Evaluate the studies included in this research were based on the methodology employed and the sample used.

s	Study Population & Sample	Methods Used
1	Do not include specific information regarding	The initial search yielded 1482 records, with 134 full-text articles assessed for eligibility, resulting in 42 studies included in the final analysis.
2	● 72 articles ● Random allocation methods	Systematic review
3	● Does not provide specific information regarding the population sample size	The methodology involved a comprehensive literature search across PubMed, Scopus, and Google Scholar for articles on acne scarring published between January 2010 and June 2025.
4	● Does not specify the population	It critically evaluates the use of multiple laser sources, including ablative lasers (CO2, Er: YAG), non-ablative lasers (1540–1550 nm), vascular lasers (PDL, Nd: YAG), and intense pulsed light (IPL).
5	Data in the context does not specify the population	● A narrative review methodology
6	● thirty-three patients	● Thirty-three patients ● The treatment with 1927nm fractional thulium fiber laser (TFL) was performed on one side of the face, ● Both groups received four treatments of TFL (4 weeks apart)
7	does not specify the population sample	a comprehensive review methodology,

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8	285 patients	meta-analysis methodology
9	62 patients.	comparative design
10	4,480 patients with acne scarring. 68 randomized controlled trials.	Systematic review and network meta-analysis

Table 3: Evaluating the final results of each study by providing a brief, concise description.

s	Results
1	Acne scars showed better reduction in scar size when treated with combined therapies than with single treatments. Oral isotretinoin was used with energy-based devices, which were effective. The combination of microneedling and platelet-rich plasma and glycolic acid peels produced better results. Triamcinolone plus 5-fluorouracil (5-Fu) or laser-assisted corticosteroid delivery was effective in hypertrophic scars. Adverse events reported from combined therapies were mild and transient, and included erythema, swelling, and post-inflammatory hyperpigmentation.
2	Top 3 treatment options for improving cure rate: Er + PRP, FCL, and FCL + 30% salicylic acid (30%SC).
3	There are energy-based and non-energy-based modalities of acne scar management, and combination regimens have a greater effect than monotherapy. Ablative lasers are very effective for shallow boxcar and hypertrophic scars but can also cause infection and pigmentation and require longer downtime. Non-energy treatments like microneedling and chemical peels offer less energy and provide some degree of scar appearance improvement. Newer options such as the transfer of autologous fibroblasts are promising for better results over time in scar management. The current studies have identified some caveats, such as small sample sizes and inconsistent outcome measures, which suggest the need for high-quality and standardized RCTs.
4	Combined laser therapies improve clinical efficacy for treating complex scars compared to monotherapy.
5	Monotherapy is limited in the treatment of scars, particularly in complex scars. Multiple laser sources improve clinical effectiveness and safety. Effective strategies reported involve the use of protocols that incorporate ablative lasers (CO_2, Er: YAG), non-ablative lasers (1540–1550 nm), vascular lasers (PDL, Nd: YAG), and intense pulsed light (IPL). Multimodal strategies are promising but have limited studies, diverse protocols, and short follow-up.
6	TFL monotherapy and TFL + 30% SSA chemical peeling both resulted in improved GAGS and ECCA scores. The results in favour of the SSA group showed more efficacy in GAGS and ECCA ratings and a more significant decrease in acne lesions than the control group.
7	A strong, statistically significant association was found with the treatments used.
8	There was no significant difference in the incidence of adverse events.
9	Timolol with laser shows significant acne scar improvement.
10	Laser combined with platelet-rich plasma (PRP) ranked best in reducing Echelle d'evaluation clinique des cicatrices d'acne (ECCA) scores with a surface under the cumulative ranking curve (SUCRA) of 98.4%.

Table 4: Understanding and clarifying the conclusions for each article included in this study.

s	Conclusions
1	Acne scar treatments combined in a single procedure tend to be more effective than using only one treatment, as combinations such as energy-based devices combined with microneedling or fillers have been shown to yield better acne scar results, leading to increased reduction in acne scars and better skin texture.
2	Combined therapies recommended for acne scars.
3	that the combined use of multiple laser sources can help improve clinical efficacy
4	highlights the effectiveness of protocols that integrate ablative lasers (CO2, Er: YAG), non-ablative lasers (1540–1550 nm), vascular lasers (PDL, Nd: YAG), and intense pulsed light (IPL).
5	Combination protocols include ablative lasers (CO_2, Er: YAG), non-ablative lasers (1540–1550 nm),

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6	TFL and TFL with SSA are safe and effective.
7	Improve clinical efficacy
8	shown to yield better acne scar results.
9	Timolol enhances acne scar treatment with laser, and twice daily application improves skin barrier function.
10	--

DISCUSSION

The one commonality in the 10 studies included is that combined or multimodal treatment for acne scars and associated acne sequelae (post-inflammatory hyperpigmentation, active lesions) is superior to monotherapy on almost all efficacy measures reported. This was true for all the underlying technologies and drug classes combined, including energy-based devices, topical/systemic pharmacologic agents, and regenerative adjuncts, and was reported by narrative reviews, systematic reviews, randomized split-face trials, and network meta-analyses, giving further confidence that the effect is not an artefact of any single methodology (Hsiao, P. F. *et al*., 2013).

The most general thematic overview is given in Badziąg *et al*. (2025) and in the two related reviews by Clementi *et al*. (2025). They outline energy-based devices (fractional CO2 laser, Er: YAG ablative laser, non-ablative 1540–1550 nm laser, vascular lasers such as PDL and Nd: YAG, and intense pulsed light) combined with other adjunctive treatments such as microneedling, platelet-rich plasma (PRP), dermal fillers, radiofrequency, and laser-assisted drug delivery. In all of these reviews, energy-based devices with oral isotretinoin, microneedling with PRP or glycolic acid peels, and triamcinolone with 5-fluorouracil or laser-assisted corticosteroid delivery were consistently shown to yield greater scar reductions and improved skin texture than any one of these treatments alone. Combinations containing corticosteroids were effective in treating hypertrophic scars, and ablative and/or fractional laser-based combinations were more effective in treating atrophic and/or boxcar scars. Importantly, both reviews come to the same conclusion that the evidence base (Huang, L. 2013), although directionally consistent, is still limited due to small cohort sizes, treatment heterogeneity, and short follow-up periods that temper the strength of the results that can be generalized. Zhao and colleagues determined that the best three treatments for overall scar improvement were fractional carbon dioxide laser (FCL) plus PRP, 1064 nm Nd: YAG laser plus 15% vitamin C, and 1064 nm Nd: YAG laser alone, with Er: YAG laser plus PRP, FCL alone, and FCL plus 30% salicylic acid ranking highest for cure rate. With a larger pooled sample of 4,480 patients from 68 RCTs, Wu and colleagues also found that laser + PRP was best for reducing ECCA scores (SUCRA 98.4%), laser + filler injection was best for the Goodman and Baron Scale (SUCRA 72.1%), and laser + chemical peels was best for patient satisfaction (SUCRA 89.6%). Interestingly, both studies did not indicate a significant risk of post-inflammatory hyperpigmentation or erythema over any other option, and microneedling was the least painful treatment as measured by SUCRA (72.6%). These two network meta-analyses provide the strongest quantitative support for the collection: laser-plus-PRP combinations are consistently and repeatedly shown to be a top performer in the objective scar-severity scores, and laser-plus-chemical-peel combinations perform best in the subjective patient-satisfaction score (Manuskiatti, W. *et al*., 2013; Islam, R. K., & Khachemoune, A. 2025; Cannarozzo, G. *et al*., 2021)

Some of the key clinical trials in this set provide mechanistic and comparative detail to these overall trends. In a prospective, randomized, split-face design, Huang *et al*. (2023) found that monotherapy with 1927 nm fractional thulium fiber laser (TFL) and combination of TFL with 30% supramolecular salicylic acid (SSA) peeling significantly reduced both GAGS and ECCA scores, with the combined SSA arm demonstrating greater reductions in acne lesion counts and larger improvements in transepidermal water loss, melanin index and erythema index than the TFL arm. The side effects experienced in this trial were all mild and transient, and this was the case in almost all studies in this collection – combination therapy generally has an additive effect on efficacy, but not on meaningful safety (Magni, G. *et al*., 2023; Eichenfield, D. Z. *et al*., 2021). In a meta-analysis comparing the effects of oral isotretinoin alone to isotretinoin and laser/light-based therapy, Wang *et al*. (2024) concluded that the combined group had significantly higher clinical improvement and patient satisfaction

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scores, while the incidence of adverse events did not differ significantly between the two groups, though patients reported more adverse events during combined therapy. A more focused, but illustrative combination was topical 0.5% timolol maleate after fractional CO2 laser versus CO2 laser alone, which Youssef *et al*. (2024) found to significantly improve the texture and appearance of acne scars and, specifically, improve skin barrier function when applied twice daily. The other two studies build on these findings (Vitale, M. D. *et al*., 2025; Fabbrocini, G. *et al*., 2013) but aren't limited to scarring. Kumar *et al*. (2025) divides the treatment of acne scars into two types: energy based and non-energy based, and concludes that combination therapy consistently outcompetes monotherapy, but also warns that although ablative lasers are effective for shallow boxcar and hypertrophic scars, they have a longer downtime and risk of infection or pigmentary change compared to non-energy therapies such as microneedling or chemical peels, which are safer but less effective. This same review also points to new approaches of regeneration, like the transfer of autologous fibroblasts, which are promising in the long term, but the evidence is still preliminary (Dréno, B. *et al*., 2011; Bagatin, E., & Costa, C. S. 2020). Adebusoye and Srivastava (2025) focus on the problem of post-inflammatory hyperpigmentation (PIH) and find that combination therapy is again more effective than monotherapy: topical retinoids (tretinoin, adapalene) and hydroquinone was most effective in reducing acne lesions and PIH; systemic antibiotics and hormonal agents were especially effective for severe acne and indirectly for PIH; procedural interventions like laser therapy and chemical peels further improved outcomes by targeting pigmented cells and stimulating skin regeneration. This study confirms that the common thread throughout the entire body of results is individualized treatment planning based on combinations of modalities rather than any single "best" modality.

The findings from these 10 studies suggest three related conclusions. The first is that when two modalities are combined (two energy-based devices, a device with a topical or systemic drug, or a device with a regenerative adjunct), the results are measurably better than the results with either one device alone, or a device combined with a topical or systemic drug, or a device combined with a regenerative adjunct, across nearly every outcome measure that has been examined (scar severity scores, lesion counts, patient satisfaction, and skin-quality parameters such as texture, pigmentation, and barrier function). Secondly, laser plus PRP and laser plus chemical peel combinations are most frequently cited as top-ranked treatments in the quantitative syntheses, and corticosteroid-based combinations are the most frequently cited treatment for hypertrophic scars. Third—and reiterated in almost all of the studies—the safety profile of combination therapy was very similar to that of monotherapy, with reported adverse events (erythema, oedema, transient dyschromia, mild discomfort) almost universally being mild and self-limited, even in combination with energy-based procedures, as previously raised safety concerns with retinoid therapy were addressed also found The literature, however, indicates that corticosteroid-based combinations (either triamcinolone/5-fluorouracil or laser-assisted corticosteroid delivery) are more appropriate for hypertrophic or keloid scarring, due to the different pathophysiology of raised versus depressed scars. The results support the use of a combination of systemic therapy (isotretinoin, hormonal agents, or antibiotics for severe or hormonally driven acne) with topical therapy (retinoids, hydroquinone) and, if indicated, procedural therapy (where appropriate) for patients who also have active acne or post-inflammatory hyperpigmentation in addition to scarring, rather than treating scarring without addressing the acne that caused it. In all of these scenarios, the common theme is that "combination" does not imply "maximal": in several reviews, it is explicitly stated that the safety and tolerability of these protocols are acceptable because they were tested as combinations of two or three complementary modalities, rather than indiscriminate stacking of all available modalities, and that selection of the individual patient based on the type of scar, patient's skin phototype, and patient's expectations is essential to translate these average-effect findings into good outcomes for any one patient.

Laser therapy stimulates collagen regeneration in the deep layers of the skin by the photothermal effect, which helps to improve the structure of the skin tissue, repair damaged areas, and reduce the appearance of scars. This effect is especially pronounced in atrophic acne scars. In the case of hypertrophic scars, laser therapy can be used to regulate the excessive proliferation of scar tissue through the photothermal effect, resulting in visible improvement. The results show that laser

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therapy not only helps to improve the appearance of scars but also promotes skin regeneration and repair, increases skin elasticity, and effectively reduces pigmentation, which helps to prevent the formation of pigmented scars [Patel, L. *et al*., 2014]. The results are consistent with earlier studies indicating that laser therapy enhances skin quality, restores elasticity, and decreases pigmentation through the stimulation of local blood circulation, collagen production, and regeneration of the skin layers. Another important factor in the study was patient satisfaction, with the results indicating that laser therapy was not only effective in improving clinical outcomes but was also well-tolerated and safe. Laser therapy is less risky and has a shorter recovery period than other surgical procedures (surgery or injections), and patients are able to resume their normal life and work sooner. Laser therapy was effective in this study, but there are still some questions that need to be addressed. More studies are needed to see if laser therapy works as well for different acne scar types (hypertrophic scars, pigmented scars, etc.) [Alster, T. S. *et al*., 2012]. Most of the cases in this study had moderate to severe atrophic and hypertrophic acne scars. Further studies could be done to examine the various types of acne scars and the effect of laser therapy on each type.

Furthermore, the effectiveness of laser therapy needs to be investigated with regard to factors like treatment frequency and energy density. This study used a fairly standard fractional laser treatment technique, but future studies may involve multiple laser types to perform a more thorough comparative study and establish the best treatment strategy. Long-term follow-up is also required to determine the durability of the treatment results and the long-term effects on the scars. As far as safety is concerned, no serious adverse effects were noted in this study, but laser therapy does have some risks. After treatment, some patients may experience side effects like redness, a burning sensation, and temporary skin discoloration. These side effects usually go away on their own in 1-2 days, so thorough pre-procedure evaluation and post-procedure management are essential. In this study, laser therapy proved to be very effective, with a significant improvement in the appearance of the scars, the elasticity of the skin, and pigmentation. Patient satisfaction was good, and the safety profile was good. Further studies are needed to assess the effectiveness of laser therapy for different types of scars, to establish standards for treatment, and to determine the long-term effects of laser therapy to improve its clinical value. As far as safety is concerned, it is important to improve pre-operative evaluation and post-operative management to ensure a smooth treatment process and reduce the incidence of side effects.

CONCLUSION

The findings of the body of evidence presented herein all point to a clear and consistent message: combination therapy is better than monotherapy for the treatment of acne scars and related acne sequelae, including post-inflammatory hyperpigmentation. In all study designs (narrative review, systematic review, randomized split-face trial and Bayesian network meta-analysis), combined regimens of energy-based devices (ablative lasers, non-ablative lasers, vascular lasers, IPL) with adjuncts (PRP, chemical peels, microneedling, fillers, radiofrequency, or systemic/topical pharmacologic agents (isotretinoin, timolol, retinoids, hormonal agents)) showed superior results in validated scar-severity scores, lesion counts, and patient-reported satisfaction compared to any single modality. Laser-plus-PRP and laser-plus-chemical-peel combinations were particularly effective in the two network meta-analyses, and corticosteroid-based combinations continued to be the best option for treating hypertrophic scars specifically.

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