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REVIEW ARTICLE

Systematic review and meta-analysis of randomized clinical trials comparing efficacy, safety, and satisfaction between ablative and non-ablative lasers in facial and hand rejuvenation/resurfacing

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Abstract

Skin aging inevitably begins from the very early days of life. The lasers used in skin rejuvenation are mainly of two types: ablative and non-ablative. This meta-analysis aimed at comparing ablative with non-ablative lasers in terms of their efficacy and safety in skin rejuvenation. Articles published by March 15, 2020 in Embase, Medline (PubMed), Scopus, Cochrane, and clinicalTrials.gov were searched. The inclusion criteria included randomized controlled clinical trials (RCTs) in English using ablative and non-ablative lasers and comparing their safety and efficiency in wrinkle improvement and photoaging therapy. Out of 1353 extracted articles, 11 were selected for qualitative synthesis and of these, 4 were quantitatively analyzed. Different modes of various lasers were implemented; the ablative lasers included Erbium: yttrium–aluminium-garnet (Er:YAG) and CO_2, besides the non-ablative lasers, comprised Ytterbium/Erbium, Erbium: Glass, neodymium: yttrium–aluminum-garnet (Nd:YAG), and alexandrite. Pooled analyses on 124 participants showed insignificant differences between ablative and non-ablative lasers in the likelihood of excellent improvement with an odds ratio of 0.83 (95% CI: 0.24, 2.83). The analyses also showed good improvement with an odds ratio of 0.88 (95% CI: 0.44, 1.78), fair improvement with an odds ratio of 1.13 (95% CI: 0.56, 2.26) and side effects with an odds ratio of 0.82 (95% CI: 0.43, 1.56). The efficacy and safety of ablative laser were not higher than those of non-ablative laser in skin rejuvenation. Given the small samples of the included articles, it is recommended that further high-quality RCTs be conducted using larger samples to confirm this conclusion.

Keywords Skin rejuvenation · Laser · Ablative · Non-ablative · Skin resurfacing · Systematic review

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Introduction

Skin ageing inevitably beginning from the very early days of life is affected by genetic and environmental factors. Ultraviolet (UV) radiation is an environmental source that influences skin ageing by producing excessive reactive oxygen species in the skin [1, 2]. This oxidative stress causes a structural and functional disturbance, visible wrinkles, pores, and elasticity loss in the skin as well as dermal matrix breakdown and pigmentation disorders [3]. This process exerts negative psychological effects on individuals and increases requests for skin rejuvenation. In 2017, over 8 million cosmetic treatments in the USA promoted self-esteem in beauty seekers and bestowed a youthful appearance on them. Skin rejuvenation methods, including the use of topical creams, are procedural and nonprocedural in type. The procedural treatments include invasive surgeries and non-invasive procedures. The latter are further categorized as non-device assisted methods such as injection of dermal fillers and Botox, and device-assisted treatments such as lasers, microneedling and radio frequency (RF) [4–6]. Numerous studies have been conducted to help practitioners with the selection of the most effective modality from their diverse types. Because of few side effects and preserving the skin's natural status coupled with fast recovery and high efficacy, the demand for lasers as device-assisted methods has increased. The lasers used in skin rejuvenation are mainly categorized as ablative and non-ablative. The same principles apply to different types of lasers despite their diverse wavelengths and target substances. The dermal heat caused by lasers repairs collagens and causes wound healing through activating and recruiting fibroblasts [7].

The present study was conducted to review the published articles on comparing the different laser-utilized methods in skin rejuvenation, thereby may help clinicians and patients with the selection of the optimal modality and protocol. Also, it provides evidence for the efficacy and safety of lasers in rejuvenation. We hypothesized that ablative lasers might have higher efficacy and subsequently higher adverse events than non-ablative ones for skin rejuvenation.

Materials and methods

Protocol and registration

This review was performed and the results were reported based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [8].

Search strategy and databases

The international databases comprehensively searched on 1st–15th March 2020 included Embase, Medline (PubMed), Scopus, Cochrane and clinicalTrials.gov. The keywords and their MeSH—used to initially retrieve the articles on the use of lasers for skin rejuvenation—included wrinkle, skin aging, photoaging and laser. Table S1 of the supplemental file presents the search strategy adopted for this study. Two researchers performed the search on the articles published by March 15, 2020. A manual search was also performed through the references of the included articles to avoid missing relevant studies.

Eligibility criteria

The eligible articles included RCTs recruiting human populations with photoaging and comparing non-ablative with ablative lasers in terms of efficacy, safety, wrinkle improvement and photoaging therapy.

The excluded articles comprised in vitro and animal studies, reviews, case reports and studies in languages other than English or published before 2010 and those used no laser modalities, or used a combination of two laser modalities, or a combination of lasers with other types of modality, or failure to compare ablative with non-ablative lasers, or discussed scar resurfacing without focusing on wrinkles and photoaging.

Screening and data extraction

After duplication removal from the primary search results, two reviewers independently screened the titles and abstracts of the retrieved articles based on the eligibility criteria and scrutinized their full-text for eligibility and data extraction. They discussed their potential disagreements and consulted a more experienced researcher in case of failure to settle the issue. The data extraction sheet included the first author's name, publication year, mean age of the participants, percentage of females, total and group sample sizes, laser type, laser name, laser parameter settings, number of sessions and their intervals, site of treatment, Fitzpatrick skin phototype, patient satisfaction score, pain score, percentages of patients with excellent improvement, good improvement, fair improvement, poor improvement and no changes, and presence of postinflammatory hyperpigmentation (PIH), crust, erythema, swelling and burning in each group. The study design, data reporting, and validity of included RCTs were assessed per the consolidated standards of reporting trials (CONSORT).

Quality assessments

Two researchers (A.G. and F.S.) who were dermatology research experts with numerous systematic reviews in this field, independently assessed the risk of bias for the individual included articles using the Cochrane risk-of-bias tool [9] and consulted a third researcher (Y.M.) who was an epidemiologist, in case of not resolving their disagreements through discussions.

Statistical analysis

The meta-analysis was performed using the logarithms of the odds ratio and its standard error. The method proposed by DerSimonian and Laird was also used to estimate the pooled odds ratio with a 95% confidence interval [10]. Cochran's Q test and the I square were applied to evaluating heterogeneity among the studies [11]. Given the low heterogeneity obtained from all the analyses, a fixed-effects model was utilized to estimate the pooled odds ratio. Moreover, publication bias was evaluated using Egger's test for funnel plot asymmetry [12, 13]. The statistical analyses were performed in STATA 14.0 (Stata Corp, College Station, TX, US) at a statistical significance threshold of $P < 0.05$ and the Alpha value was set at 5% and Beta value as 20%. Therefore, the power of the study was 80% and the confidence interval was 95%, also the risk of bias was measured in Review Manager 5.2 (Nordic Cochrane Centre, Cochrane Collaboration, Copenhagen, Denmark).

Results

Study selection

Out of the 1353 retrieved articles through the initial search, 352 duplicate ones were excluded and the remaining 1001 were screened by two reviewers. After excluding 784 irrelevant articles, the full-texts of 217 studies were examined for eligibility. Eleven articles comparing ablative with non-ablative lasers in skin rejuvenation and wrinkle reduction were qualitatively synthesized and 4 comparing ablative with non-ablative lasers in terms of efficacy and safety underwent quantitative syntheses. Figure 1 shows the PRISMA flow diagram.

Analyses

Qualitative analysis

Among the 11 eligible RCTs published in 2010–2019, ten [14–23] (6 split-body and 4 parallel-group) evaluated lasers in facial rejuvenation and one [24] (split-body) in hand rejuvenation.

This systematic review analyzed the data of 365 patients (523 sites) and 33 patients (66 sites) respectively undergoing facial and hand rejuvenation. Table 1 summarizes the characteristics and results of the articles.

Quantitative analyses

Quantitative syntheses involved 4 RCTs [18, 20, 22, 24] recruited 124 patients with a mean age of 45–59 years and including three articles investigated only females and one addressed both genders (females:79%, males:21%). All these patients participated in three sessions of laser therapy for 4 weeks and their Fitzpatrick skin phototype was II to IV. Ninety-one of these patients underwent laser treatment for facial wrinkles and photoaging and 33 for hand wrinkles.

Efficacy of ablative versus non-ablative lasers

The pooled analyses showed insignificant differences between ablative and non-ablative lasers in terms of the likelihood of excellent, good and fair improvements with pooled odds ratios of 0.83 (95% CI:0.24, 2.83), 0.88 (95% CI:0.44, 1.78) and 1.13 (95% CI:0.56, 2.26), respectively. An insignificant heterogeneity was observed between the studies in terms of the estimated odds ratios of excellent, good and fair improvements under ablative compared to non-ablative lasers ($P = 0.76$, $P = 0.72$ and $P = 0.73$, respectively). Figures 2, 3, 4, and 5 show the forest plots,

Fig. 1 The PRISMA flow diagram of the included studies

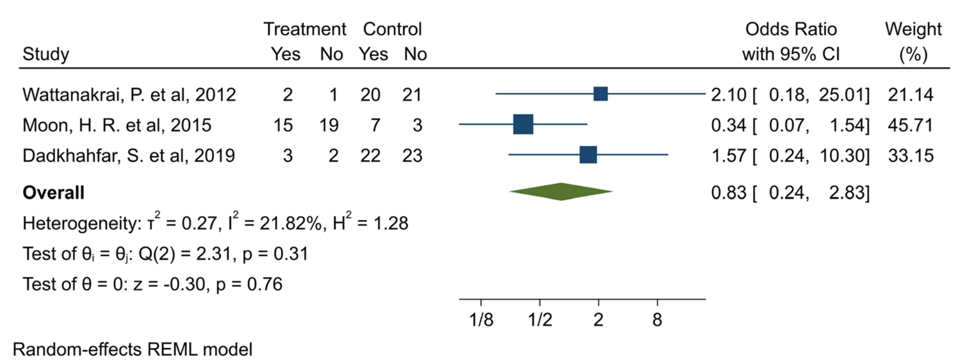

Table 1 Summary of the characteristics and results of the included studies

Author, country	Treatment Site	Mean age	Gender	Follow-up period	Type and name of the Laser	Laser parameter settings	treatment sessions number	Number of patients	Main results
Wattanakrai, Thailand- 2012 [18]	face	46.1	100% female	3 months	Non ablative laser: Fractional 1,550-nm Ytterbium/ Erbium Fiber Laser	Energy 12 mJ, Density 100 microscopic treatment zones (MTZ) /cm^2 in three passes to a total of 300 MTZs, hand piece 2.5 cm^2	3	22	• There was no significant difference between the two groups in terms of rates of the clinical improvement • Early side effects were more pronounced in the non-ablative laser group while in the later course, ablative laser side effects were more pronounced • The fractional non-ablative laser was associated with lower downtime and more overall satisfaction
					Ablative laser: Variable Square Pulse 2,940-nm erbium:yttrium–aluminum-garnet (Er:YAG) laser	First pass: Pulse width 600 µs, energy 0.77 J/cm^2, Spot size 7 mm Second pass (wrinkles only): Long-pulsed, Energy 4.24 J/cm^2, Spot size 3 mm Third pass: Pulse width 300 µs, energy 1.29 J/cm^2, Spot size 7 mm	3	22	
Moon, Korea- 2015 [20]	face	45.77	79.0% female, 21.0% male	3 months	Ablative laser: Fractional Er:YAG laser	Pulse width 1000 ms, Pulse energy output 2.5 mJ	3	22	• Greater improvement was achieved by the Er: Glass laser • The Er: Glass laser caused fewer side effects and had lower treatment related pain • Patient satisfaction was greater after using the non-ablative laser
					Non-ablative laser: Fractional 1550-nm Er:Glass laser	Energy 12 mJ/MTZ	3	22	

Table 1 (continued)

Author, country	Treatment Site	Mean age	Gender	Follow-up period	Type and name of the Laser	Laser parameter settings	treatment sessions number	Number of patients	Main results
Dadkhahfar, Iran-2019 [22]	face	59.91	100% female	6 months	Ablative laser: Fractional Er:YAG laser	Pulse duration 350 µs, Fluency 1200 mJ/cm^2, Pixel number 30/cm^2, Pixel size 270 µm, Repetition rate 3–5 Hz, Spot size 7 mm	3	25	• The ablative laser and non-ablative laser had similar safety and efficacy • Non-ablative lasers such as long pulse Nd:YAG had no to minimal downtime
					Non-ablative laser: Long pulse Nd:YAG laser	Pulse Duration 20 ms, Fluency 20–24 J/cm^2, Spot 10 mm	3	25	
Robati, Iran- 2018 [24]	hand	54.94	100% female	-	Ablative laser: Fractional Er:YAG laser	Pulse duration 350 µs, Fluence 3.12 J/cm^2, Pulse Energy 1–1.2 J, Repetition rate 3–5 Hz, Spot size 7 mm	3	33	• Both the long pulse Nd:YAG laser and the fractional Er:YAG laser were effective and safe, and had similar satisfaction for hand rejuvenation
					Non-ablative laser: Long pulse Nd:YAG laser	Pulse Duration 5 ms, Fluence 10–20 J/cm^2, Spot size 7 mm	3	33	
Luo, China- 2012 [17]	face	50	100% female	3 months	Ablative laser: Ultrapulse-mode fractional CO_2 laser	Scan size 10 mm, Peak power 200 W, Spot size 120 µm, Density 361 MTZ/cm^2, Energy 10 mJ, Beam width 50–80 µs, Ablation width 120 µm	1	18	• There was no significant difference between the two groups in terms of the clinical improvement • Patients preferred $SPCO_2$ due to similar efficacy, fewer adverse effects and pain • $SPCO_2$ had longer downtime in comparison to $UPCO_2$
					Ablative laser: Superpulse-mode fractional CO_2 laser ($SPCO_2$)	Scan size 10 mm, Peak power 60 W, Spot size 120 µm, Density 361 MTZ/cm^2, Energy 10 mJ, Beam width 150–250 µs, Ablation width 120 µm	1	18	

Table 1 (continued)

Author, country	Treatment Site	Mean age	Gender	Follow-up period	Type and name of the Laser	Laser parameter settings	treatment sessions number	Number of patients	Main results
Somoano, USA- 2011 [16]	face	-	-	3 months	Ablative laser: Lower fluence (LF) Er:YAG laser	Fluency 2.5 J/cm^2	3	46	• High-fluency lasers could improve wrinkles • High-fluency lasers had higher side effects • Patients were more satisfied with low-fluency lasers and preferred to continue therapy with low-fluency ones
					Ablative laser: Higher fluence (HF) Er:YAG laser	Fluency 3.8 J/cm^2	3	46	
Karsai, Germany-2010 [14]	face	46.1	92.9% female, 7.10% male	3 months	Ablative laser: Fractional CO_2 laser	Pulse Energy 15 and 20 mJ, Pulse Duration 10 ms, Total density 20%, Spot size 120 µm	1	28	• Fractional CO_2 lasers and fractional Er:YAG lasers were not different in terms of final cosmetic outcomes and post-treatment downtime • Patients had similar satisfaction with Er:YAG lasers and the fractional CO_2 lasers
					Ablative laser: Fractional Er:YAG laser	Pulse Duration: 400 µs, Total Fluence 60 J/cm^2	1	28	
Robati, Iran- 2017 [21]	face	45.50	100% female	3 months	Ablative laser: Fractional CO_2 laser	Power 20–18 mJ/cm^2, Distance 1 mm, overlap 1 step, Scattering Mode	3	40	• Both fractional CO_2 and fractional Er:YAG lasers were effective and safe in the treatment of facial skin wrinkles • Er:YAG lasers might be a more convenient option for skin rejuvenation due to its lower downtime and post-therapy discomfort
					Ablative laser: Fractional Er:YAG laser	Pulse Duration 350 µs, Fluence 3.12 J/cm^2, Pulse Energy 1.2 J, Repetition rate 3–5 Hz	3	40	

Table 1 (continued)

Author, country	Treatment Site	Mean age	Gender	Follow-up period	Type and name of the Laser	Laser parameter settings	treatment sessions number	Number of patients	Main results
Yim, Korea- 2019 [23]	face	63.8	96.0% female, 4.0% male	20 months	Non-ablative laser: Picosecond 1064 long pulsed Nd:YAG laser	Fluency 0.6–0.8 J/cm^2, Pulse duration 450 picosecond, Spot size 8 mm, Frequency 10 Hz	5	25	• The picosecond 1064-nm Nd:YAG laser was not inferior to the quasi-long pulsed 1064-nm Nd:YAG laser • None of these lasers had severe adverse events
					Non-ablative laser: Quasi-long-pulsed 1064-nm Nd:YAG laser	Fluency 4 J/cm^2, Pulse duration 0.3 ms, Spot size 8 mm, Frequency 10 Hz	5	25	
Lee, Korea- 2012 [15]	face	41.8	90.3% female, 9.7% male	1 month	Non-ablative laser: Long-pulsed 755-nm alexandrite	Pulse duration 3 ms, Fluency 20–26 J/cm^2, Spot size 8–12 mm	1	62	• Both of the Long-pulsed 755-nm alexandrite and long-pulsed 1064-nm Nd:YAG were safe and effective for facial rejuvenation
					Non-ablative laser: long-pulsed 1064-nm Nd:YAG	Fluency 40–50 J/cm^2, Spot size 10 mm. Facial Telangiectasia treatment: Fluency 300 J/cm^2, Pulse duration 20 ms, Spot size 1.5 mm	1	43	
El-Domyati, Egypt-2013 [19]	face	-	59.0% female, 41.0% male	6 months	Ablative laser: Short pulsed ablative Er:YAG laser	Pulse duration 350 µs, Fluency 3–5 J/cm^2, Spot size 5 mm	1	6	• The resurfacing ablative laser remained the gold standard for rejuvenating but was associated with higher long-term sequelae and patient downtime
					Ablative laser: Fractional Er:YAG laser	Pulse duration 300 µs, Fluence 1200 mJ/cm^2, Pixel number 30/cm^2, Pixel size 270 µm, Spot size 10 mm	4	6	

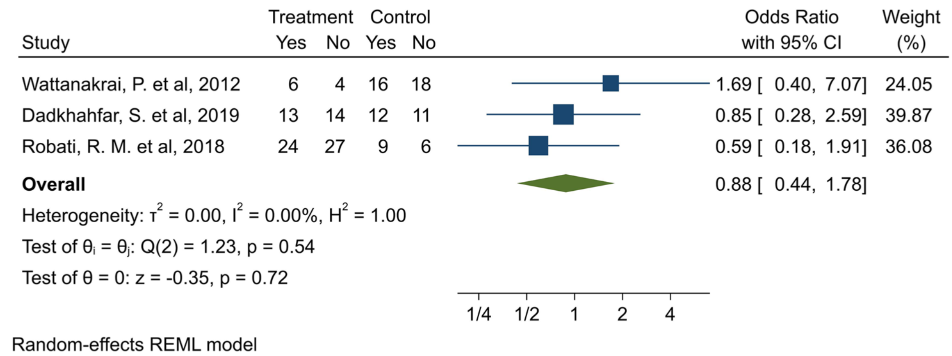

Fig. 2 The pooled odds ratio of excellent improvement in ablative lasers in comparison to non-ablative lasers

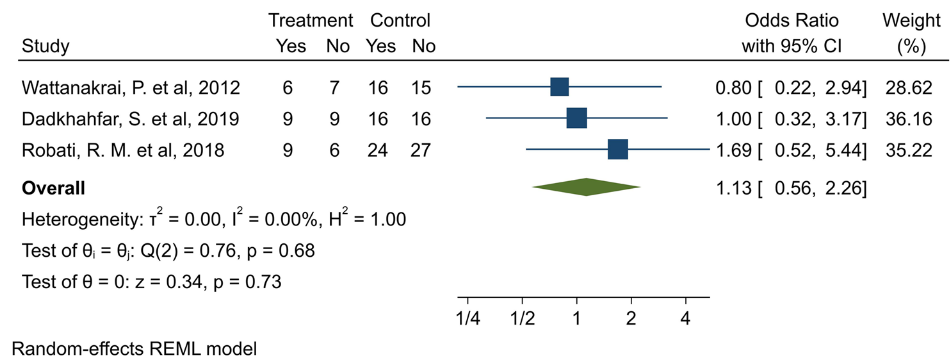

Fig. 3 The pooled odds ratio of good improvement in ablative lasers in comparison to non-ablative lasers

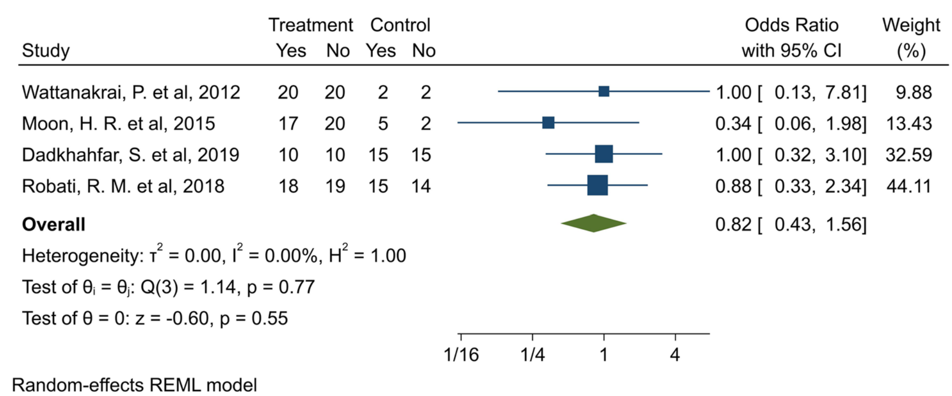

Fig. 4 The pooled odds ratio of fair improvement in ablative lasers compared to non-ablative lasers

estimating the pooled odds ratios of excellent, good and fair improvements under ablative and non-ablative lasers.

Safety of ablative versus non-ablative lasers

The pooled analyses showed insignificant heterogeneity between the studies ($P = 0.55$) and insignificant differences in the likelihood of side effects between ablative and non-ablative lasers with a pooled odds ratio of 0.82 (95% CI: 0.43, 1.56).

Risk of bias in the included studies

The quantitative analyzed eligible articles were investigated for all the potential sources of bias. The main risks of selection, detection, and performance bias were low in all but one article. Figure 6 shows the individual and aggregate risks of bias for the individual studies.

Fig. 5 The pooled odds ratio of safety in ablative lasers compared to non-ablative lasers

Discussion

Dermatologists may face the challenge of choosing the most appropriate method from diverse skin rejuvenation modalities, especially lasers with few side effects, fast recovery and high satisfaction rates. Laser modalities are mainly categorized as ablative and non-ablative in type. Ablative lasers are more aggressive, penetrating both the epidermis and dermis and inducing collagen synthesis with a wound-healing mechanism. The cooling mechanism of non-ablative lasers prevents epidermal effects. This modality mainly causes dermal effects with fewer complications. Contradictory results have been reported in the literature for the efficacy and safety profile of the two types of laser. This study reviewed and compared literature on lasers and provided an overview of their efficacy and safety.

Summary of evidence

In facial rejuvenation, 3 out of the 10 RCTs compared non-ablative with ablative lasers [18, 20, 22], one compared two modalities of the same non-ablative laser [23], one compared two types of non-ablative laser [15] and five compared 2 ablative lasers with each other (3 investigated different modes or fluency levels of the same ablative laser [16, 17, 19] and two others compared two different types of ablative laser [14, 21]. Only 1 RCT compared ablative with non-ablative lasers in hand rejuvenation [24].

Ablative versus non-ablative lasers in rejuvenation

Facial rejuvenation

A three-session clinical trial for facial skin rejuvenation by Wattanakrai et al. estimated clinical improvement at 60% and satisfaction at 90% in two groups that underwent a non-ablative fractional 1550 nm Ytterbium/Erbium fiber laser and an ablative 2940 nm variable square pulse Er:YAG laser. Early side effects were more noticeable in the non-ablative laser group, whereas late adverse effects were more frequently observed in the ablative group. The fractional non-ablative laser was therefore associated with lower downtime and higher satisfaction [18].

A three-session trial by Moon et al. reported excellent clinical improvements in 68% of patients underwent an

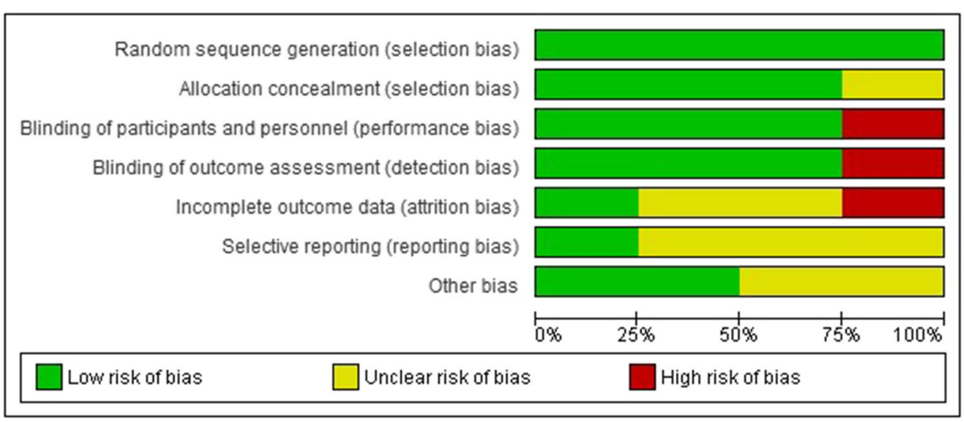

Fig. 6 The risk of bias; reviewing authors' judgments about each risk of bias for each included study

ablative fractional 2940 nm Erbium-doped Yttrium aluminium garnet (Er:YAG) laser and 87% of those underwent a non-ablative fractional 1550 nm Erbium-doped glass (Er: Glass) laser for facial rejuvenation. The overall satisfaction was respectively estimated at 76% and 90% in the ablative fractional and non-ablative fractional groups. Significant reductions in pigmentation and significant increases in uneven tone/erythema scores were observed in Er:YAG ablative fractional resurfacing, and significant decreases in wrinkle scores were reported in the Er: Glass used in non-ablative fractional resurfacing. Although a combination therapy generally appeared more effective in facial rejuvenation in Asian skin, comparing the two types of laser showed greater improvements, lower treatment-related pains and fewer adverse events after Er: Glass non-ablative fractional resurfacing [20].

A three-session trial by Dadkhahfar et al. reported excellent or good therapeutic responses to a non-ablative long-pulse Nd:YAG laser and a fractional ablative Er:YAG laser in over 60% of patients underwent facial rejuvenation. Although Er:YAG was comparable with long-pulse Nd:YAG laser in facial rejuvenation, the downtime of the latter made it more popular among the patients. Despite the initially-expected superiority of fractional ablative lasers over non-ablative lasers in rejuvenation, similar safety and efficacy were reported for these two modalities using subjective and objective measurements. The zero or negligible downtime of, non-ablative lasers such as long-pulse Nd:YAG also made it more favourable given the lifestyle in the industrial world [22].

Research suggests the overall superiority of non-ablative rejuvenation lasers, especially the fractional modality, owing to their higher satisfaction rate and similar efficacy and safety compared to those of ablative lasers. This finding contradicts previously-reported results suggesting the superiority of ablative lasers in rejuvenation; nevertheless, a combination of treatments, including ablative and non-ablative lasers, might constitute the optimal strategy for the ageing skin as long as different types of laser are properly adjusted.

Hand rejuvenation

A three-session trial by Robati et al. reported an overall clinical improvement of about 30% and a satisfaction rate of 50% in two groups underwent hand rejuvenation using a fractional ablative Er:YAG laser and a non-ablative long-pulse Nd:YAG laser. They recommended a combination strategy for hand rejuvenation despite observing the effectiveness and safety of both long-pulse Nd:YAG laser and fractional Er:YAG laser [24].

Comparing two types of ablative laser or two modalities of the same ablative laser

Two different modalities of the same ablative laser

A single-session trial by Luo et al. reported a clinical improvement of about 30% after three months in two groups underwent ablative lasers, including ultrapulse-mode fractional CO_2 laser (the higher peak power and lower beam width) and superpulse-mode fractional CO_2 lasers ($SPCO_2$) (the lower peak power and higher beam width). Although objective and subjective assessments did not show significant differences in therapeutic improvements between the two modalities, the patients preferred $SPCO_{2,}$ owing to its similar efficacy, fewer adverse effects and lower pain at the expense of a longer downtime [17].

El-Domyati et al. compared a short-pulsed ablative Er:YAG laser used in a single-session with four sessions of a fractional ablative Er:YAG laser in facial rejuvenation. Although they reported the significant effects of both types of laser on the epidermis and dermal collagen, elastin and tropoelastin, the resurfacing ablative Er:YAG laser exerted more significant effects on the epidermal thickness, elastin and tropoelastin. Despite the insignificant differences between the two types of laser in their effects on collagen (neocollagen formation and collagen types I, III, VII), multiple sessions of skin resurfacing using a fractional short-pulsed ablative Er:YAG laser was more favourable in terms of improving dermal collagen, safety and downtime. Excellent or good clinical responses were also observed in 83% of the patients in the short-pulse group and 67% in the fractional laser group. This study suggested that resurfacing ablative lasers remain the gold standard for rejuvenation despite their higher long-term sequelae and longer downtime [19].

A three-session trial by Somoano et al. found that both low-fluency and high-fluency ablative Erbium micropeel lasers to improve cutaneous dyschromia in facial rejuvenation; nevertheless, only the high-fluency laser improved wrinkles with overall clinical improvements of about 25% and 35% in the low-fluency and high-fluency protocols, respectively. Given the higher side effects caused by the high-fluency laser, the patients were ultimately more satisfied with the low-fluency laser [16]. A review of the literature suggests $SPCO_2$, fractional ablative Er:YAG laser and low-fluency Er:YAG laser constitute the optimal and most favourable modalities, due to their higher satisfaction and comparable efficacy and safety with those of other modes of the same laser type.

Two different types of ablative laser

Karsai et al. compared fractional ablative CO_2 lasers with fractional ablative Er:YAG lasers. They found a single session of both the ablative lasers to cause a clinical improvement of about 60% and excellent improvements in over 80% of cases undergoing facial rejuvenation. They observed insignificant differences between the two laser types in cosmetic outcomes and post-treatment downtime. The insignificantly higher satisfaction with Er:YAG laser than with fractional CO_2 laser did not affect the patients choice [14].

A three-session trial by Robati et al. estimated overall clinical improvements at 39.6% and 40.4% in two groups underwent facial rejuvenation using fractional ablative CO_2 lasers and ablative Er:YAG, respectively. Despite observing the effectiveness and safety of both fractional CO_2 and fractional Er:YAG lasers in treating facial skin wrinkles, they found fractional Er:YAG laser more convenient for skin rejuvenation, owing to its acceptable efficacy, shorter downtime and fewer post-therapy complications [21].

Studies comparing CO_2 with Er:YAG as the two most popular fractional ablative lasers suggest the promising future of Er:YAG, owing to its similar efficacy and safety, higher satisfaction rates and shorter downtime.

Comparing two types of non-ablative laser and two modalities of the same non-ablative laser

Two different modalities of a non-ablative laser

A five-session trial by Yim et al., comparing two modalities of a non-ablative laser, i.e. a 1064 nm picosecond long-pulsed Nd:YAG versus a quasi-long-pulsed 1064 nm Nd:YAG reported the same effectiveness for both modalities in treating photoaging facial wrinkles and pores (about 50%) and found no severe adverse events using either method during the study period [23].

Two types of non-ablative laser

Lee et al. found a single session of two types of non-ablative laser, i.e., a long-pulsed 755 nm alexandrite laser and a long-pulsed Nd:YAG laser, to be effective and safe in facial skin rejuvenation and reported a clinical improvement of over 50% [15].

Non-ablative lasers appear a proper rejuvenation option, especially for patients with a modest downtime and the highest tolerability.

Study limitations

As the main limitation of this study, the failure of the trials to report the results in terms of quartile improvements prevented their inclusion in the quantitative analyses of this study. The small samples of the included trials could have also affected the final evaluation.

Conclusion

A large body of the literature has been devoted to laser therapy in aesthetic dermatology, especially in rejuvenation, resurfacing and scars [25–28]. This systematic review and meta-analysis compared different types of laser in facial and hand rejuvenation. No differences were observed between ablative and non-ablative lasers in skin rejuvenation in terms of improvement rates and adverse events. The two types of lasers resulted in satisfactory improvements and none of them was found superior to the other, therefore, our null hypothesis was rejected. Studies comparing ablative with non-ablative lasers revealed similar outcomes and reported insignificant differences between the two modalities despite considerable improvements they caused. Given the small samples of the included studies, it is recommended to perform high-quality comprehensive RCTs in order to confirm the present findings. It is worth noting that the other effective factors in clinically selecting a rejuvenation modality include availability of devices, the background skin characteristics of patients and their preference and previous treatments.

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Author contribution A.G designed the study, F.S searched the databases, F.S and A.P screened the initial search results and extracted data from the included studies, Y.S and H.D performed the meta-analysis, A.G, F.S, A.P, and P.P wrote the final manuscript and all the authors extensively contributed to the final draft of this manuscript. A.G and P.P also edited the document.

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Declarations

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