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Comparative Study of the Safety and Efficacity of Microneedling with Tranexamic Acid and Vitamin C Versus Peeling with Trichloroacetic Acid (TCA) in the Treatment of Melasma

Imane T*, Eljouari O and Gallouj S

Department of Dermatology, University Hospital Center Mohammed VI, Morocco

***Corresponding author:** Talhaoui Imane, Department of Dermatology, University Hospital Center Mohammed VI, Tangier 40000, Morocco, Tel: 00212634171882; Email: drimane95@gmail.com

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Abstract

This study contrasts the safety and effectiveness of two melasma therapy methods: trichloroacetic acid (TCA) peeling and microneedling in combination with tranexamic acid (TA) and vitamin C. Over the course of six months, 30 female patients with moderate to severe epidermal melasma, ages 18 to 50, participated in a prospective, randomized, open-label trial. Patients were split into two groups: Group II had microneedling with TA and vitamin C, and Group I had 15% TCA peels. The Modified Melasma Area and Severity Index (MASI) score change, as measured at baseline, during therapy, and at follow-up, was the main end measure. The microneedling group exhibited a greater improvement (mean MASI score reduction from 9.11 to 5.21) than the TCA group (mean MASI score reduction from 22.97 to 13.16), according to the results, which indicated a substantial decrease in MASI scores in both groups. Furthermore, compared to 13.33% in the TCA group, 40% of patients in the microneedling group experienced an improvement of greater than 50%. Erythema, burning, and itching were among the mild and temporary side effects; no severe adverse events were noted. In comparison to TCA peeling, the study finds that microneedling with tranexamic acid and vitamin C is safer and more successful for treating melasma. It provides better management of hyperpigmentation with fewer adverse effects. For medical professionals looking for safe and efficient melasma treatment options, this strategy offers a viable substitute.

Keywords: TCA; Microneedling; MASI

Introduction

Melasma is a skin disorder that mostly affects sun-exposed facial regions such the forehead, cheeks, and upper lip and is characterized by the formation of brown or dark-colored patches [1]. Despite being frequently thought of just a cosmetic concern, melasma has a substantial negative influence on sufferers' mental health. Its severe emotional and social repercussions are highlighted by the disorder's visible form, which frequently results in decreased self-confidence and social awkwardness. According to Wood's light intensity, melasma can be histologically divided into three types: mixed, dermal, and epidermal. Because melanin is distributed superficially, the epidermal form,

which is the most prevalent and is distinguished by strong light intensification, usually responds better to therapy [2]. Depending on the affected locations, melasma can appear clinically in three different ways: mandibular, malar, and centrofacial [3]. Oral tranexamic acid, pycnogenol, and vitamin C are examples of systemic therapies that have demonstrated promise [4]. There are several approaches to treating melasma. First-line therapy frequently involves topical treatments, particularly a fixed triple mixture of hydroquinone, retinoic acid, and fluocinolone acetonide [5]. Second-line therapies include chemical peels and oral tranexamic acid, which are sometimes used in combination with topical treatments [4]. For patients who are resistant, third-line therapies such as lasers may be tried [5].

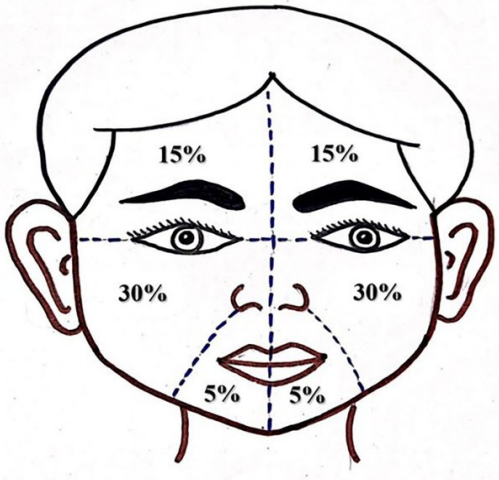
Melasma is influenced by a number of factors, including hereditary vulnerability, hormone therapy, pregnancy, endocrine dysfunctions, and UV exposure. This widespread condition, which is more prevalent in women with darker skin phototypes, affects millions of people globally [6]. Trichloroacetic acid (TCA) is a safe and affordable choice among chemical peels. Unlike some peels, TCA doesn't need to be neutralized, and the amount of icing it causes is correlated with how far it penetrates. To get satisfactory results, however, several sessions are typically required [7]. Localized intradermal microinjections of tranexamic acid (TA) [8] and trans epidermal administration of TA via microneedling [9] are recent developments in the treatment of melasma that have shown notable effectiveness in clinical trials. In this study, two treatment modalities-15 percent TCA chemical peels and microneedling with tranexamic acid and vitamin C-will be thoroughly compared. Evaluating their safety profiles and effectiveness in treating melasma is the main goal. In order to improve patient outcomes, this research aims to offer insightful information that can help doctors make well-informed treatment decisions.

Materials and Methods

With Institutional Review Board (IRB) Ethical Committee permission, a six-month prospective, randomized, open-label study was carried out from January 2023 to June 2023. There were thirty participants in the study, fifteen in each therapy group. Female adults with moderate to severe bilaterally symmetrical melasma between the ages of 18 and 50 were eligible subjects. Prior to enrollment, all individuals provided written informed consent. Pregnant or nursing women, people on oral contraceptives, people with a history of bleeding problems or concurrent use of anticoagulants, people with known drug allergies, people with related medical conditions, and people who had received depigmenting therapies in the previous month were also excluded. The study only included individuals who had epidermal-type melasma, as determined by Wood's light examination.

Melasma severity was evaluated using the Modified Melasma Area and Severity Index (MASI). MASI scores were computed and recorded at baseline, prior to each treatment session, and throughout follow-up by a blinded dermatologist who was not engaged in the study. In order to support the evaluation, photographs were also collected during baseline and follow-up visits [10].

MODIFIED MASI SCORE



FRONTAL: 15% MALAR: 30% CHIN: 5%

0.15 (A)(D+H)+ 0.3(A)(D+H)+ 0.05(A)(D+H)

Area (A) of melasma involvement:
0 = No involvement
1= less than 10%
2= 10- 29%
3 =30- 49%
4=50-69%
5= 70-89%
6= 90-100%

Darkness of pigmentation (D)
0 = absent
1= slight
2= mild
3 =marked
4= severe

Homogeneity (H)
0 = Normal
1= specks of involvement
2= small patchy area <1.5 cm diameter
3 =patches of involvement > 2 cm in diameter
4=uniform skin involvement without any clear areas

The peeling process phases were as follows: Group I, which included 15 patients, received a 15% TCA peel, and Group II, which included 15 patients, received microneedling with TA in addition to vitamin C (5 mg/5mL).

Group 1: 15% TCA was applied up until the frosting. Unless the patient experienced discomfort, erythema, burning, or stinging that prevented them from completing the session, this was repeated every ten days. Ten days apart, six consecutives were performed.

Group 2: The region to be treated was covered with topical EMLA cream for about 45 to 60 minutes following a mild cleaning. The employed microneedles were 2 cm wide and studded with 192 tiny, medical-grade stainless steel needles. The needle measured 0.25 mm in diameter and 1.5 mm in length. The needles pierce the skin somewhere between 0.1 and 1.3 mm, depending on the pressure used.

Clinical photos were taken at the start of the therapy and thereafter on a serial basis to evaluate the clinical response. Every month, MASI score, physician global assessment (PGA), and patient global assessment (PtGA) were conducted, and any problems or unfavorable occurrences were documented. At the conclusion of the trial, each patient's response to treatment was assessed as follows: no response, no improvement; mild response, less than 25% improvement; moderate response, 25% to less than 50% improvement; good response, 50% to less than 75% improvement; and very good response, greater than 75% improvement. Every case was monitored for three months to check for any relapses or additional progress. The means of MASI scores at each visit and follow-up following treatment in each group were compared using the Kruskal-Wallis (nonparametric ANOVA) test. The means of MASI scores for the TCA peel group and the microneedling group were compared using the unpaired test with Welch correction. Thirty melasma patients participated in the trial.They're all women.

Results

Fifteen (50%) of the thirty participants in the research were between the ages of forty and fifty (Table 1). Fitzpatrick skin types of 4 or 5 were seen in all cases. The majority of patients showed malar melasma distribution patterns.80% of patients have melasma on their skin. About 18 (60%) of the patients had a risk factor of sun exposure. Of the patients, 21 (70%) had a family history of melasma.

They were all free of phototoxic substances. In the past, four individuals (13.33%) in the microinjection group and five individuals (13.33%) in the TCA group had undergone melasma treatment using chemical peels, skin lightening agents, and certain indigenous medications. Moisturizers were used by eight participants in the TCA group and eight in the microneedling group.

Age	TCA	Microneedling	Total
18-29	1(6.67%)	2(13,33%)	3(10%)
30-39	5(33,33%)	7(46,67%)	12(40%)
40-50	9(60%)	6(40%)	15(50%)
Total	15	15	30

Table 1: Age distribution.

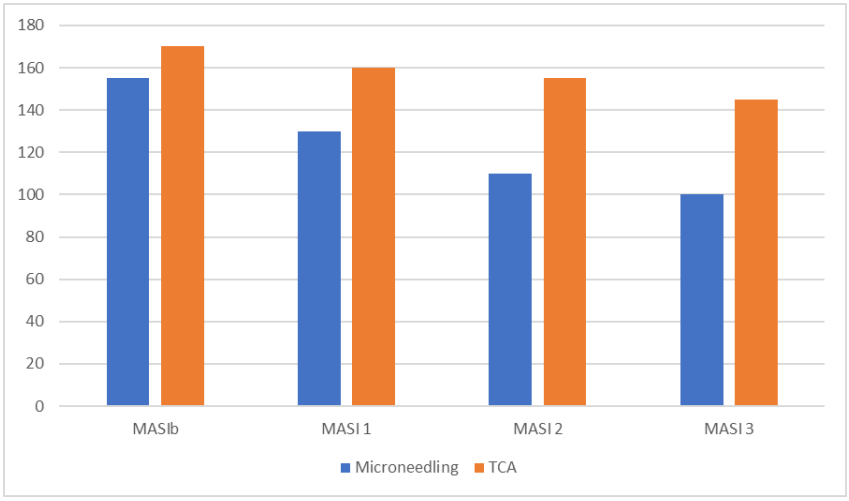
By the end of the third follow-up, the microneedling group's overall MASI score had dropped from 160 (MASIb) at the first visit to 114 (MASI2) at the third visit and then to 102 (MASI3). At the first visit, the TCA group's overall MASI score was 173.5 (MASIb); by the third visit, it had dropped to 157.8 (MASI2), and by the conclusion of the third follow-up, it had dropped to 147.5 (MASI3).

Table 3 lists the average MASI scores at each visit and follow-up for both treatment groups. At baseline, the microneedling group's mean MASI score was 9.11 ± 4.09 (MASIb); by the end of the third follow-up, it had dropped to 5.21 ± 2.05 (MASI3), with a statistically significant P-value of less than 0.01. At baseline, the TCA group's mean MASI score was 22.97 ± 4.36 (MASIb); by the conclusion of the third follow-up, it had dropped to 13.16 ± 4.49 (MASI3), with a highly significant P-value of <0.001 (Graph 1). With a P-value of 0.006, there was a significant difference in the mean MASI scores between the microneedling and TCA groups.

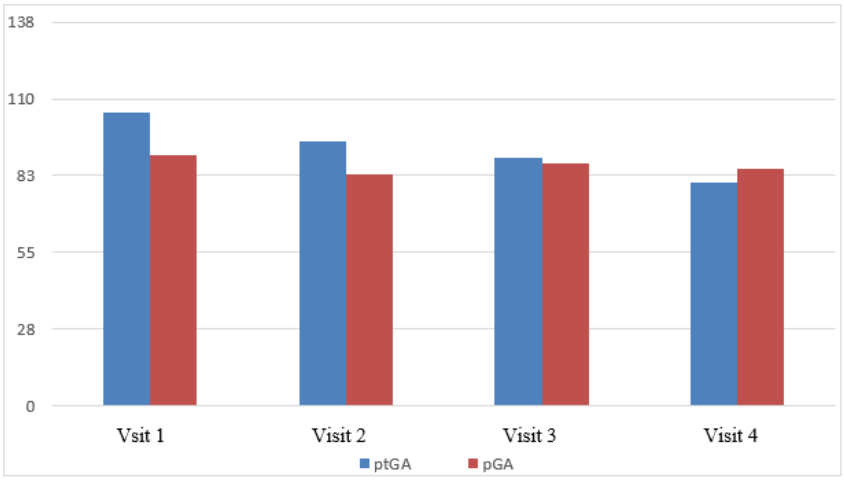
Compared to two patients in the TCA group, six patients in the microneedling group had improvements of greater than 50%. None of the patients, nevertheless, saw an improvement of more than 75%. (Graph 2) shows the results of the Physician Global Assessment (PGA) and Patient Global Assessment (PtGA). The comparison photos show clinical improvement (Figures 1 and 2). Only minor discomfort, a burning feeling, and erythema were noted as adverse effects; most patients experienced these go away in 1-2 days. No significant side effects were documented (Tables 2-4).

	TCA group	P value	Microneedling Group
Baseline MASI	22.97 ± 4.36	-	9.11±4.09
At 4 weeks	19.890 ± 3.56	<.001	6.15±2.52
At 8 weeks	17.117 ± 4.26	<.001	5.41±2.41
AT 12 weeks	13.160 ± 4.49	<.001	5.21±2.05

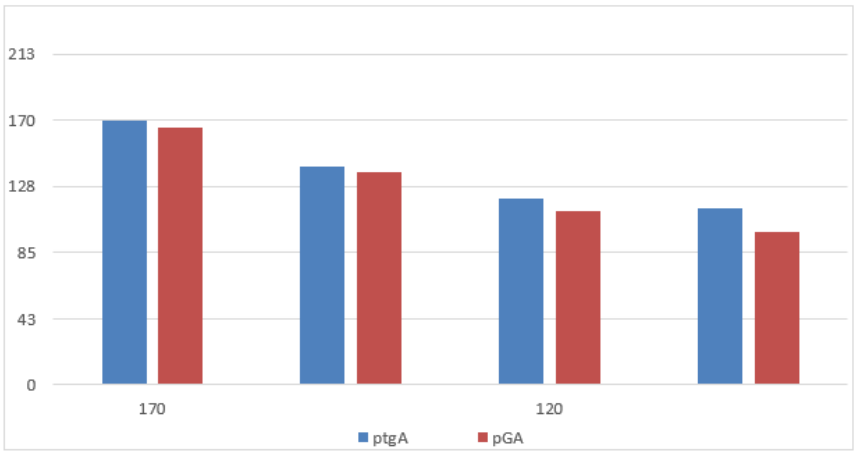
Table 2: Change in MASI within the groups throughout the treatment period.



Graph 1: Improvement in grading of MASI with various agents.



Graph 2: Total PGA and PtGA scores at different visits in the microneedling group.



Graph 3: Total PGA and PtGA scores at different visits in the TCA group.

Réponse	Microneedling	TCA
<25	4	7
25-50	3	6
50-75	5	2
75-100	1	0

Table 3: Percentage improvement of MASI scores in both the groups.

	Microneedling	TCA
Prurit	3	1
Erythème	4	6
Brulures	2	3
Total	9	10

Table 4: Side effects encountered during the study.

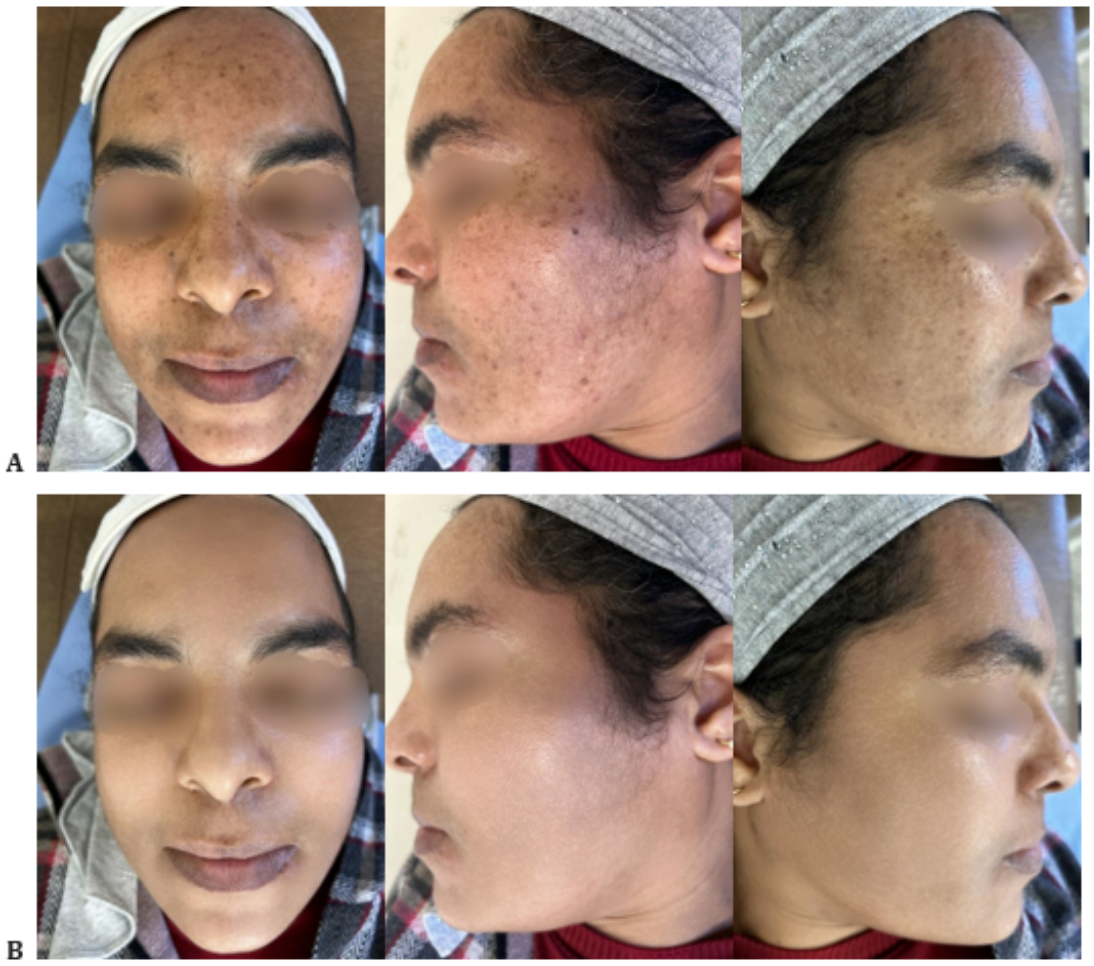


Figure 1: Melasma at baseline.
After 12 weeks.
Treatment with microneedling with tranexamic acid and vitamin C.

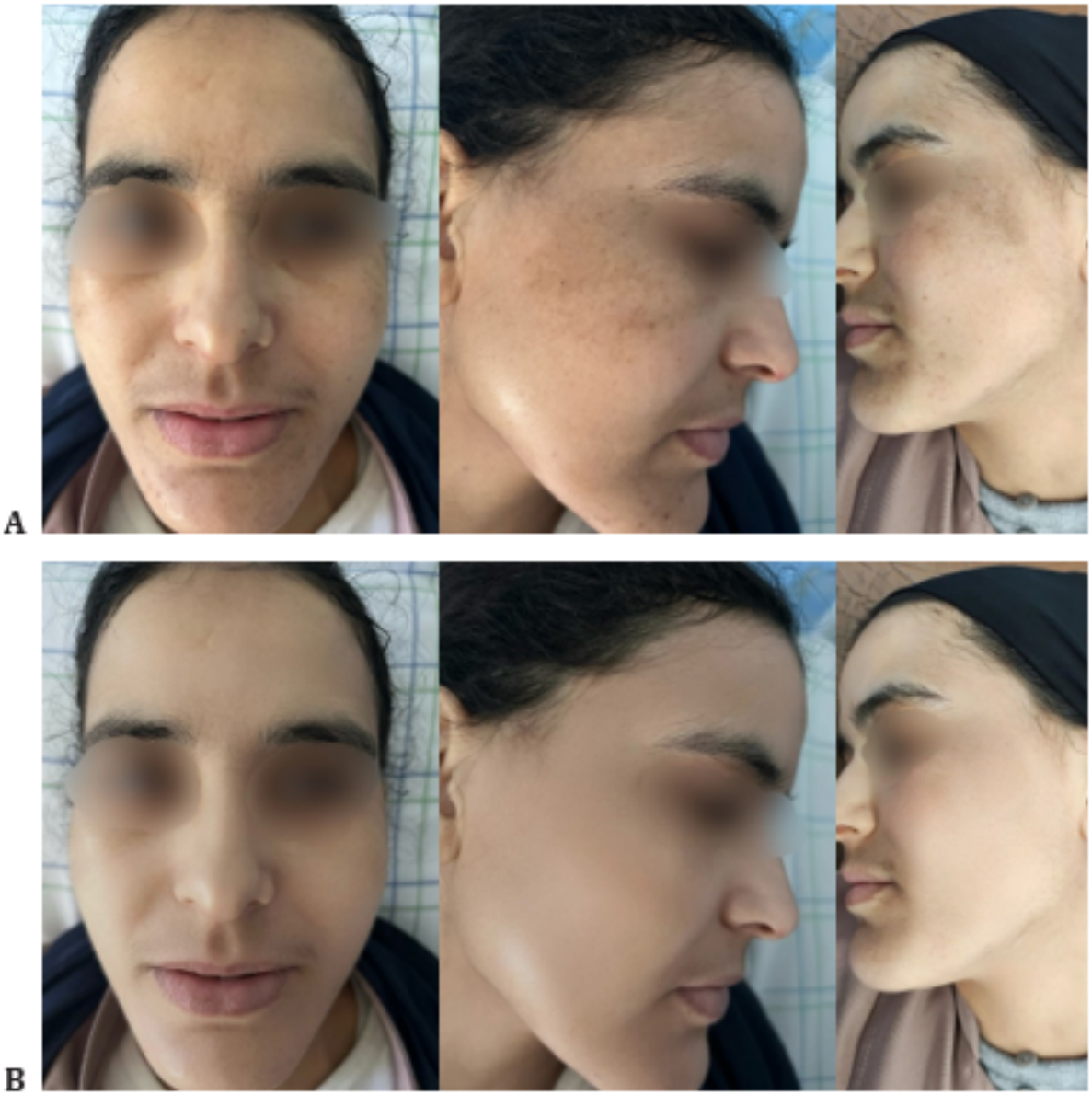


Figure 2: Melasma at baseline.
After 12 weeks.
Treatment with peeling with TCA.

Discussion

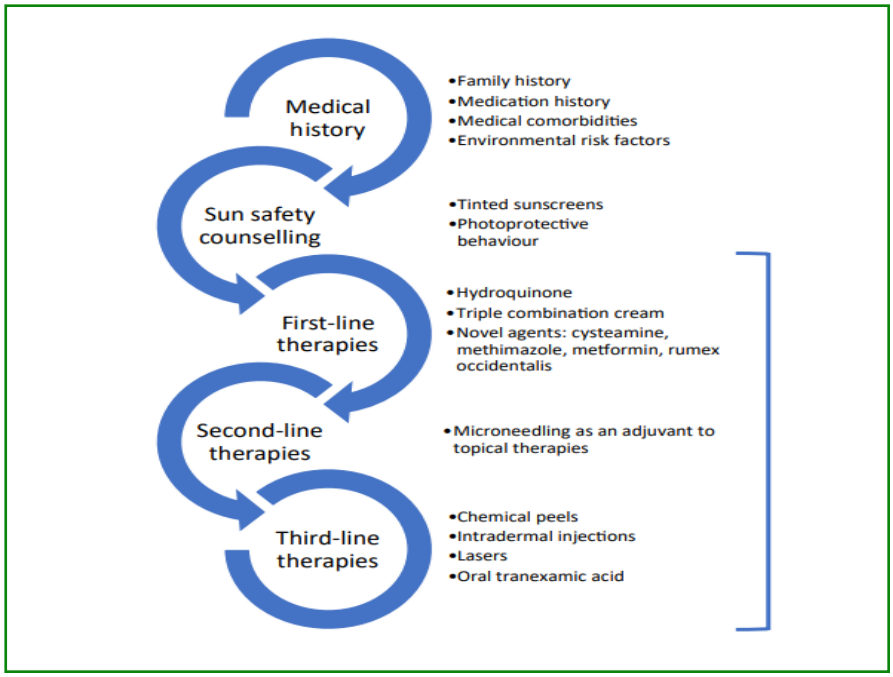
Among chemical peeling agents, trichloroacetic acid (TCA) is regarded as the gold standard because of its affordability, stability, and adaptability. It has been thoroughly researched and can produce superficial, medium-depth, and deep peels without posing a risk of systemic toxicity. TCA is straightforward to give since, unlike some other agents, it does not require neutralization, and the depth of the peel corresponds with the intensity of skin icing [11,12]. TCA can be applied as a stand-alone treatment (up to 30% for full-face peels or up to 50% for localized application) [13] or in conjunction with topical vitamin C and other therapies to treat melasma. Although it is best known for treating hemorrhagic and antifibrinolytic disorders, tranexamic acid (TA) has showed potential in the treatment of hyperpigmentation. According to recent research, topical TA prevents plasminogen from attaching to keratinocytes, which lowers plasmin activity, prostaglandin synthesis, and melanocyte tyrosinase activity and prevents UV-induced

pigmentation [8]. This process could account for its efficacy in lowering melasma hyperpigmentation, especially in dermal-type instances, where intradermal TA injections have also been investigated [9].

Chemical peels are divided into groups according to how deeply they penetrate. While medium-depth peels (35-50% TCA) reach the papillary or reticular dermis, superficial peels focus on the epidermis. Deep peels are linked to increased risks of adverse effects and prolonged healing durations since they pierce the reticular dermis. TCA causes protein precipitation and coagulative necrosis of epidermal cells when given topically; greater amounts cause collagen necrosis in the dermis. Eventually, the necrotic layers come off, allowing the epithelium of hair follicles to regenerate the skin [8]. Microneedling involves the controlled creation of microchannels in the epidermis and dermis, which enhance the penetration of active ingredients. This process triggers dermal remodeling, increasing collagen synthesis and facilitating the deeper absorption of therapeutic agents like tranexamic acid and vitamin C [11]. Tranexamic acid inhibits melanin production by reducing plasmin activity and prostaglandin synthesis, while vitamin C acts as a potent antioxidant, preventing oxidative stress-induced pigmentation. Studies indicate that microneedling allows for deeper and more uniform distribution of these agents, leading to more significant improvements in melasma compared to chemical peels. Furthermore, this technique reduces the risk of post-inflammatory hyperpigmentation, making it suitable for darker skin types [12].

This is the first study to compare TCA peeling and microneedling with tranexamic acid and vitamin C for the treatment of melasma. Consistent with previous studies involving 30 individuals, the data show that tranexamic acid plus vitamin C is superior to TCA peeling. In comparison to the TCA group, the microneedling group's MASI scores improved noticeably more. One session of a combination chemical peel was shown to be just as successful in curing melasma as six sessions of TCA peels, according to a recent study comparing TCA peels with combined peels. In contrast, a 2013 study conducted in India examined the delivery of TA using microneedling and targeted microinjections, or mesotherapy. MASI scores, PtGA, and PGA decreased statistically significantly using both approaches from baseline to the fourth, eighth, and twelfth weeks. The difference was not statistically significant, despite microneedling showing a little superior improvement. This could be explained by the deeper and more consistent medication distribution that microneedling provides. Over the course of the three-month follow-up, all scores stayed constant.

Recent studies have investigated various treatment modalities for melasma, with a focus on chemical peels, laser therapies, and microneedling-assisted drug delivery. Research suggests that microneedling enhances transepidermal drug absorption, leading to improved treatment outcomes. Studies by Lee et al. (2006) and Maeda & Naganuma (1998) have demonstrated the efficacy of tranexamic acid in reducing melasma severity, particularly when combined with microneedling. Additionally, comparative trials have shown that microneedling yields superior results compared to conventional chemical peels, with fewer side effects and lower relapse rates. To provide a structured approach for dermatologists in managing melasma based on its severity, we have outlined the following treatment algorithm [13].



Conclusion

In summary, this comparative study provides important insight into the safety and effectiveness of two melasma therapy methods: trichloroacetic acid (TCA) peeling and microneedling with tranexamic acid and vitamin C. The findings demonstrate that, in comparison to TCA peeling, microneedling in conjunction with tranexamic acid and vitamin C significantly improves MASI scores while controlling hyperpigmentation and causing fewer adverse effects. For patients looking for a safe and efficient melasma treatment, this strategy appears to be more advantageous. To put it briefly, this research may help physicians choose treatments that combine safety and effectiveness, satisfying patients' demands for long-lasting effects.

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