

Microneedling and narrowband UVB in vitiligo: clinical insights on the efficacy and patterns of repigmentation

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Abstract

Introduction: Vitiligo is a relatively common acquired pigmentary disorder, characterized by a progressive loss of melanocytes. In stable vitiligo, treatment via microneedling followed by narrowband ultraviolet B (NB-UVB) phototherapy showed significant improvement. The goal of this study was to evaluate and compare the safety and efficacy of microneedling with NB-UVB versus NB-UVB alone in the treatment of stable vitiligo.

Methods: This comparative study included 92 vitiligo lesions from 46 patients with stable vitiligo (confirmed by Wood's lamp) treated at the Assiut University Hospitals dermatology outpatient clinic between October 2023 and June 2024. All patients underwent a detailed history, general and local examination, and a Vitiligo Extent Score (VES) assessment. Lesions were divided into two groups: Group 1 ($n = 46$) received weekly microneedling plus NB-UVB twice a week, and Group 2 ($n = 46$) received NB-UVB twice a week only, both for 3 months.

Results: Both groups showed a significant decrease in the VES; however, Group 1 demonstrated significantly greater improvement compared to Group 2 ($p < 0.001$). Furthermore, lesions on the upper extremities and trunk in Group 1 exhibited a significantly higher VES score reduction after treatment compared to Group 2 ($p = 0.03$ and 0.01 , respectively). Peripheral repigmentation was the most common pattern, followed by perifollicular and mixed repigmentation, with no significant difference between the groups.

Conclusions: Microneedling plus NB-UVB had significantly higher efficacy than NB-UVB alone, especially on the trunk and upper extremities. A peripheral repigmentation pattern was most common, followed by perifollicular and mixed repigmentation.

Keywords: NB-UVB, medical dermatology, microneedling, therapy treatment, vitiligo

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Introduction

Vitiligo is a common, chronic, and acquired pigmentary disorder characterized by well-demarcated depigmented macules and patches that appear secondary to the destruction and/or dysfunction of melanocytes. Vitiligo affects individuals worldwide, with a global prevalence estimated to be approximately 1%, although reports vary considerably across regions, ranging from 0.1% to 8.8% of the population (1).

The management of vitiligo remains a significant clinical challenge because no single therapy has universally proved to be effective and sufficient alone. In many cases, multimodal approaches are required to achieve satisfactory repigmentation, yet the outcomes of such combined regimens can be inconsistent (2).

Medical therapies for vitiligo encompass a wide spectrum of options, including topical agents such as corticosteroids and calcineurin inhibitors, phototherapy, topical psoralen combined with sunlight, targeted phototherapy using a 308 nm excimer laser, and systemic agents, including immunosuppressants (3). Among these modalities, narrowband ultraviolet B (NB-UVB) phototherapy is currently considered an effective intervention for generalized vitiligo, offering superior repigmentation outcomes, color matching, and tolerability compared to psoralen-based photochemotherapy (4).

Microneedling has emerged as a promising adjunctive approach in dermatology. It involves the controlled creation of micro-channels in the skin using fine needles, thereby enhancing trans-

dermal drug delivery and accelerating therapeutic effects. This technique increases cutaneous drug absorption while preserving partial epidermal integrity, which facilitates rapid recovery and minimizes the risk of infection or scarring (5). Microneedling stimulates melanocyte migration and helps in repigmentation of vitiligo lesions (6). Therefore, it may act synergistically with NB-UVB phototherapy to improve the treatment outcomes of vitiligo.

The aim of the study was to evaluate the clinical efficacy, safety, tolerability, and repigmentation patterns associated with the combined use of microneedling and NB-UVB compared to NB-UVB monotherapy in patients with stable vitiligo.

Methods

This was a prospective comparative clinical study conducted on patients with stable vitiligo, contributing a total of 92 lesions, who were treated at the Assiut University Hospitals dermatology department between October 2023 and April 2024. The diagnosis of stable vitiligo was established clinically and confirmed with Wood's lamp examination.

Eligibility criteria

Inclusion criteria comprised cooperative patients presenting with two symmetrical non-segmental vitiligo lesions of various durations and anatomical sites that consented to undergo the procedure and adhere to the treatment and follow-up schedules.

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Exclusion criteria included patients with active vitiligo, those that had received topical or systemic therapy or phototherapy within the preceding month, pregnant women, individuals with a history of bleeding disorders or on anticoagulant therapy, patients predisposed to keloid or hypertrophic scar formation, and those with active cutaneous infections at the treatment site. Additional exclusions included patients with the Koebner phenomenon or photosensitivity disorders.

Clinical assessment

A detailed history was obtained for all patients, including demographic data (age, sex, occupation, and residence), disease characteristics (onset, duration, course, and prior therapies), past medical history (associated cutaneous or systemic conditions, the Koebner phenomenon), and family history of vitiligo or related disorders such as premature hair graying. A general physical examination was performed to assess overall health status. Dermatological examination included characterization of the vitiligo type, distribution, and associated features, and Wood's lamp examination was employed to confirm depigmented lesions. Patients were instructed to avoid topical creams and refrain from washing the target area on the day of the Wood's lamp evaluation. The lesions were randomized to select either treatment modality.

Documentation and scoring

Standardized digital photos were taken at baseline, monthly prior to each treatment session, and after the completion of therapy, using the same lighting and positioning for consistency. The Vitiligo Extent Score (VES) and Vitiligo Extent Score-Plus (VES-Plus) were calculated at baseline and at 3 months post-treatment to quantify the disease extent and therapeutic response. Repigmentation was graded on a 5-point scale: 0 = no change; 1 = 1%–25% repigmentation (fair); 2 = 26%–50% (moderate); 3 = 51%–75% (good); and 4 = 76%–100% (excellent).

Microneedling procedure

For the combination therapy group, each vitiliginous patch was sterilized with 70% isopropyl alcohol, and topical anesthesia (lidocaine-prilocaine cream) was applied under occlusion for 30 minutes before being completely removed. Microneedling was performed using an automated needle device Dr. Pen® A6S wireless (Guangzhou Ekai Electronic Technology Co., Guangzhou, China) equipped with 1.5 mm needles. Each session was followed by the application of topical antibiotics to reduce infection risk. A new sterile needle cartridge was used for every session. Treatments were administered once a week for a maximum of 12 sessions or until satisfactory repigmentation occurred.

Narrowband ultraviolet B

Phototherapy was administered with a Waldmann UV 100 L device (Herbert Waldmann GmbH & Co. KG, Villingen-Schwenningen, Germany). Treatment commenced with an initial dose of 200 mJ/cm², delivered two to three times weekly, with dose increments of 10% to 20% per session, depending on tolerance. When asymptomatic erythema occurred within 24 hours, the preceding dose was maintained until resolution. The maximum permissible dose was 1,500 mJ/cm² for the face and 3,000 mJ/cm² for body sites.

Outcome assessment

Treatment responses were independently evaluated by two blinded dermatologists (for which the responses were recorded if there was inter-observer agreement) using the VES and standardized photos at baseline and 3 months post-intervention (the standard clinical threshold for evaluating vitiligo treatment). The patterns of repigmentation, safety, and tolerability were documented throughout the follow-up period.

Ethical considerations

All participants were fully informed about the study's aims, procedures, and potential risks. Oral and written informed consent was obtained, with assurance of the right to withdraw at any stage without consequences for medical care. Patient confidentiality was preserved by anonymizing data and restricting access to the research team. The study protocol was approved by the local medical ethics committee, Faculty of Medicine, Al-Azhar University, and conducted in accordance with the ethical principles outlined in the Declaration of Helsinki.

Statistical analysis

Data analysis was performed using Stata/IC version 16.1 (StataCorp LLC, College Station, TX, USA) and GraphPad Prism version 8.0.2 (GraphPad Software, La Jolla, CA, USA). Qualitative data were presented as frequencies and percentages, and quantitative data were summarized as range, mean, standard deviation, median, and interquartile range. The normality of data distribution was assessed, and appropriate statistical tests were applied. Statistical significance was considered at $p < 0.05$.

Results

A total of 46 patients presented with vitiligo patches affecting upper extremities (41.3%), trunk (28.3%), lower extremities (17.4%), and face (13.0%). Group 1 (microneedling plus NB-UVB) showed a statistically significant improvement compared to Group 2 (NB-UVB only; $p < 0.001$; Table 1).

The mean VES score of vitiligo lesions at different sites of both groups was significantly lower after treatment when compared to the baseline. There was no statistically significant difference in the mean baseline VES score of vitiligo lesions of both groups at different sites when compared to each other. However, the patches in the upper extremities and trunk in Group 1 showed a significantly higher reduction in the VES score after treatment when compared to Group 2 ($p = 0.033$ and 0.021 , respectively; see Table 2). Figures 1–4 show selected examples of clinical improvement.

An excellent response (> 75%) was achieved in 13 lesions (28.3%) in Group 1 versus five lesions (10.9%) in Group 2, and a

Table 1 | Percentage of improvement in vitiligo patches.

Percentage improvement	Group 1 (microneedling plus NB-UVB), n (%)	Group 2 (NB-UVB), n (%)	Wilcoxon test
> 75%	13 (28.3)	5 (10.9)	
50%–75%	16 (34.8)	11 (23.9)	
25%–49%	14 (30.4)	22 (47.8)	
< 25%	3 (6.5)	8 (17.4)	
Mean ± SD	59.96 ± 25.54	38.82 ± 24.40	$p < 0.001^{***}$

Data presented as mean ± SD and frequency (%), statistical significance set at $p < 0.05$.

*** statistically significant. NB-UVB = narrowband ultraviolet B, SD = standard deviation.

good response (50%–75%) was achieved in 16 lesions (34.8%) in Group 1 compared to 11 (23.9%) in Group 2. On the other hand, moderate response (25%–49.9%) was achieved in 14 lesions (30.4%) in Group 1 versus 22 lesions (47.8%) in Group 2, and a fair response (< 25%) was detected only in three lesions in Group 1 (6.5%) versus eight lesions (17.4%) in Group 2 (Table 1). No major adverse effects were observed in any of the groups. Mild transient erythema occurred in all lesions and resolved spontaneously.

There was no significant difference between the lesions treated with microneedling plus NB-UVB (Group 1) versus NB-UVB only (Group 2) regarding the pattern of repigmentation with p -value = 0.477 (Table 3).

In terms of the relation between the improvement and demographic data of patients, in Group 1 (microneedling plus NB-UVB) the patches on the upper extremities and trunk were associated with a significantly higher rate of improvement when compared to the patches on the face and trunk ($p = 0.034$). In contrast, in Group

2 (NB-UVB treated patches) there was no statistical difference of improvement for different sites of vitiligo. On the other hand, the remaining demographic characteristics did not show a significant difference in any group (Table 4). Using the Pearson correlation test, both the patients' age and duration of lesions revealed no statistically significant correlation with improvement (Table 5).

Discussion

Vitiligo is an acquired multifactorial disorder characterized by a progressive loss of pigmentation in the skin, hair, and mucosal surfaces. It is associated with profound clinical and psychosocial consequences, particularly in individuals with darker skin photo-types (7). This study was designed to evaluate the comparative efficacy and safety of microneedling combined with NB-UVB versus NB-UVB monotherapy in the management of stable vitiligo. The magnitude of improvement of microneedling combined with NB-

Table 2 | Vitiligo Extent Score (VES) score of vitiligo patches.

	Group 1 (microneedling/plus NB-UVB)	Group 2 (NB-UVB)	p -value, Wilcoxon test
Upper extremities			
Before	0.32 (0.18)	0.33 (0.21)	0.888
After	0.12 (0.10)	0.18 (0.13)	0.033*
p -value	< 0.001*	< 0.001*	
Trunk			
Before	0.32 (0.18)	0.30 (0.15)	0.387
After	0.10 (0.10)	0.21 (0.12)	0.021*
p -value	0.001*	0.003*	
Lower extremities			
Before	0.30 (0.19)	0.19 (0.11)	0.102
After	0.17 (0.10)	0.12 (0.09)	0.362
p -value	0.012*	0.028*	
Face			
Before	0.31 (0.32)	0.18 (0.14)	0.144
After	0.14 (0.19)	0.09 (0.08)	0.462
p -value	0.027*	0.028*	

Data presented as mean $\pm$ SD and frequency (%), statistical significance set at $p < 0.05$.

*significant. NB-UVB = narrowband ultraviolet B, SD = standard deviation.

Table 3 | Repigmentation pattern in vitiligo patches.

Pattern	Group 1 (microneedling plus NB-UVB), n (%)	Group 2 (NB-UVB), n (%)	p -value
Peripheral	21 (45.7)	16 (34.8)	0.477
Perifollicular	10 (21.7)	12 (26.1)	
Mixed	15 (32.6)	13 (28.3)	
No pigmentation	0 (0.0)	5 (10.9)	

Data presented as mean $\pm$ SD and frequency (%), statistical significance set at $p < 0.05$.

NB-UVB = narrowband ultraviolet B

Table 5 | Correlation of improvement between patients' age and the duration of lesions; statistical significance set at $p < 0.05$.

	Duration (area reduction in cm ²)			
	Group 1		Group 2	
	r	p -value	r	p -value
Age (years)	0.23	0.119	0.12	0.412

Table 4 | Effects of selected demographic data on improvement.

Variable	Group 1		Group 2	
	Mean $\pm$ SD	p -value	Mean $\pm$ SD	p -value
Sex				
Female	56.89 $\pm$ 24.58	0.337	36.73 $\pm$ 24.19	0.496
Male	64.31 $\pm$ 26.90		41.78 $\pm$ 25.05	
Family history				
No	62.18 $\pm$ 24.30	0.402	40.27 $\pm$ 23.43	0.566
Yes	55.36 $\pm$ 28.23		35.80 $\pm$ 26.89	
Type of vitiligo				
Non segmental	63.34 $\pm$ 23.91	0.154	39.86 $\pm$ 23.02	0.648
Focal	51.36 $\pm$ 28.44		36.15 $\pm$ 28.43	
Site				
Upper extremities	64.25 $\pm$ 26.13	0.034*	45.70 $\pm$ 19.24	0.130
Trunk	68.76 $\pm$ 23.55		27.64 $\pm$ 22.52	
Lower extremities	37.60 $\pm$ 16.60		33.33 $\pm$ 30.72	
Face	57.10 $\pm$ 24.78		48.54 $\pm$ 28.67	

Data presented as mean $\pm$ SD and frequency (%), statistical significance set at $p < 0.05$.

*significant. SD = standard deviation.

UVB compared to standard NB-UVB was 2.6- and 1.5-fold for > 75% and 75%–50%, respectively.

At the end of the follow-up period, both treatment groups demonstrated a statistically significant reduction in the mean VES,

confirming the effectiveness of NB-UVB therapy. However, patients receiving microneedling in combination with NB-UVB showed a greater reduction in VES, alongside a higher mean percentage of clinical improvement compared to NB-UVB monotherapy.

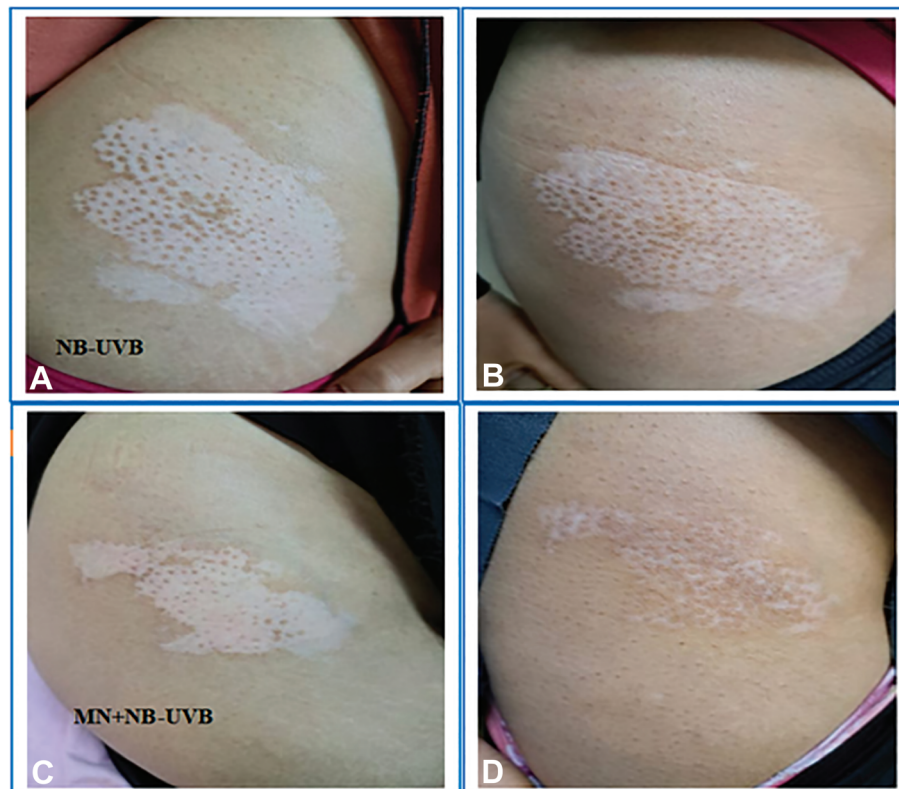


Figure 1 | A 19-year-old female patient with stable vitiligo on both thighs of 5 years duration. Left side treated with narrowband ultraviolet (NB-UVB) alone (A) before and (B) after treatment. Right side treated with NB-UVB plus microneedling (C) before and (D) after 3 months of treatment.

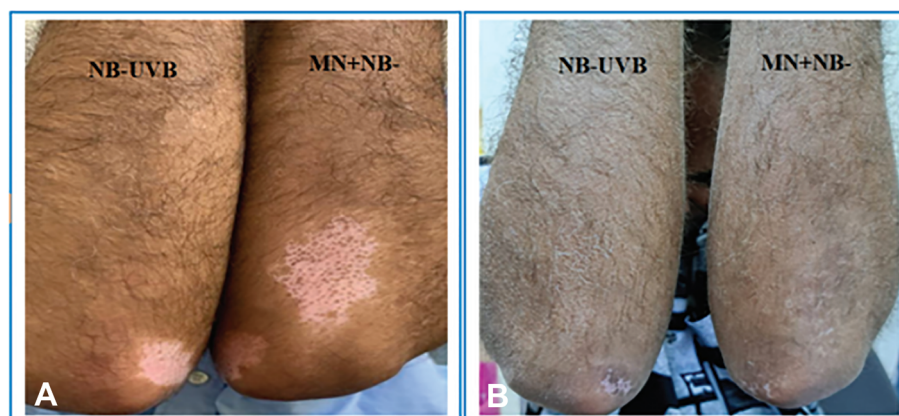


Figure 2 | A 39-year-old male patient with stable vitiligo on both elbows of 4 years duration, (A) before and (B) after 3 months of treatment.

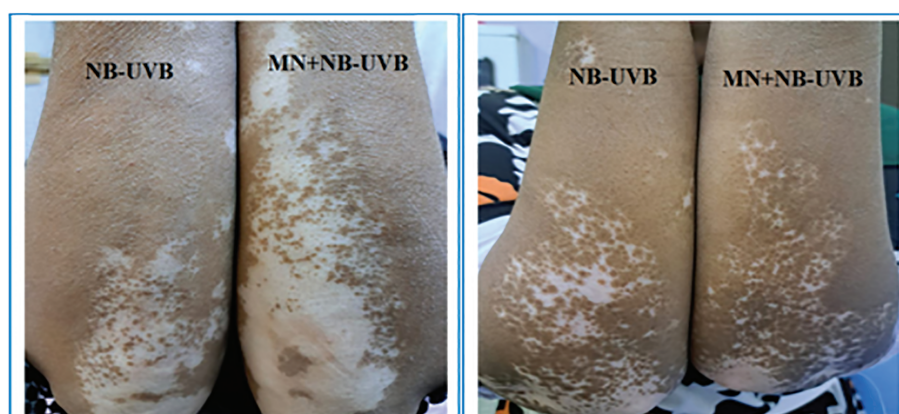


Figure 3 | A 39-year-old female patient with stable vitiligo on both elbows of 7 years duration, before and after 3 months of treatment.

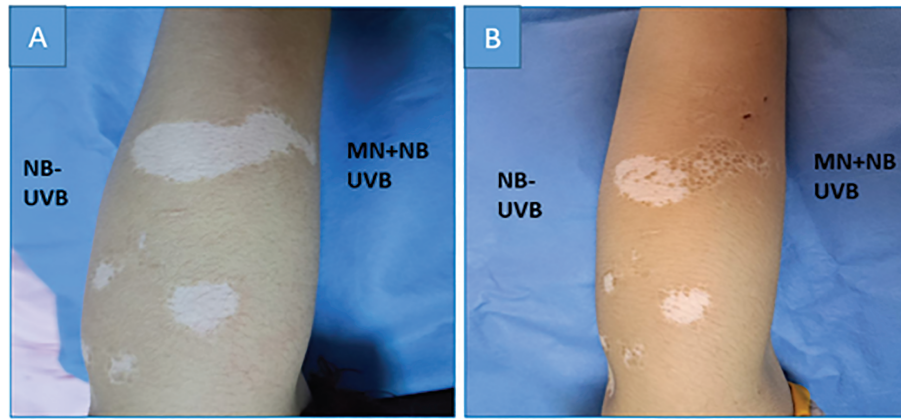


Figure 4 | A 29-year-old female patient with stable vitiligo on the right arm of 1 year duration. Left side treated with narrowband ultraviolet (NB-UVB) and right side treated with microneedling plus NB-UVB (A) before and (B) after 3 months of treatment.

In our hypothesis, microneedling may enhance NB-UVB response by stimulating local wound-healing pathways, increasing melanocyte migration from hair follicles, promoting growth factor release, and improving phototherapy penetration. Recent reports have concluded that microneedling combined with tacrolimus is considered a safe and effective intervention for vitiligo treatment (8).

Our findings are consistent with those of Elshafy et al., who performed a comparative study on 60 patients with acrofacial vitiligo to evaluate the efficacy of needling with topical corticosteroids, NB-UVB, or their combination. They reported that, even though NB-UVB alone achieved moderate outcomes, the addition of needling significantly enhanced repigmentation, particularly when combined with NB-UVB, with up to 70% of patients achieving a good-to-excellent response (9). Our study aligns with these observations, despite differences in the methodology (i.e., we did not use topical corticosteroids, and our evaluation was based on the VES scores rather than the Dermatology Life Quality Index). Peripheral repigmentation likely reflects melanocyte migration from the surrounding normal skin, whereas perifollicular repigmentation indicates the activation of follicular melanocyte reservoirs.

Similarly, a systematic review and network meta-analysis by Zhu et al. involving 28 studies and 1,194 participants revealed that combination therapies consistently outperformed NB-UVB monotherapy in inducing successful repigmentation (10). Among these, microneedling or needling combined with NB-UVB is ranked among the most effective non-invasive strategies. These findings lend further support to the results of our study.

In contrast, Esmat et al. evaluated microneedling and needling as adjuncts to NB-UVB in 20 patients with stable acral vitiligo and found no significant differences compared to NB-UVB monotherapy in terms of clinical improvement, melanocyte count, or VES for a Target Area scoring (4). The discrepancies between their results and the results of our study could be explained by the differences in the number of patients (we included more patients), follow-up duration, lesion location (acral vs. mixed anatomical sites), and assessment tools. Moreover, acral sites are notoriously resistant to therapy due to fewer hair follicles serving as melanocyte reservoirs, which may explain their poor response.

Anatomical location is a critical factor in determining treatment response. Several studies, including those of Zhu et al. and Shin et al., have highlighted that acral sites and extremities are less responsive compared to the trunk and face (10, 11). In contrast, Eşme et al. and Kim et al. suggested that treatment outcomes

depend more on the therapeutic protocol (e.g., the microneedle size and NB-UVB dosing frequency) than on the anatomical site alone (12, 13). In this study, repigmentation was most frequently peripheral, followed by perifollicular repigmentation and, finally, mixed patterns, with no significant intergroup differences. These findings may be explained by the role of NB-UVB in attracting melanocytes from the surrounding normal skin, thereby promoting marginal repigmentation (2, 14).

Our observations differ from those of Khullar et al., who reported perifollicular repigmentation as the predominant pattern in both NB-UVB monotherapy and combination therapy groups (14). Marginal and mixed patterns were less frequent in their study. These differences may again be attributed to methodological variations, including patient population, follow-up duration, and the repigmentation scoring system employed.

Finally, the technique of microneedling is simple, relatively inexpensive, and easily applicable in outpatient dermatology settings, making it a practical adjunct to standard phototherapy. This study has several limitations. First, no formal sample-size calculation was performed, which may have limited the statistical power of the study and the precision of the estimated treatment effects. Second, microneedling is associated with procedure-related pain, and individual differences in pain tolerance may influence treatment acceptability and adherence. Although the discomfort is generally transient and resolves shortly after the procedure, this may limit its suitability for some patients. Finally, microneedling may be less practical for treating large skin areas, which could restrict the generalizability and clinical applicability of this treatment approach.

Conclusions

The management of stable vitiligo remains challenging, with multiple therapeutic modalities offering variable outcomes. This comparative clinical study assessed the efficacy of microneedling combined with NB-UVB versus NB-UVB alone in symmetrical lesions of the same patient. Both groups showed significant improvement in the VES scores; however, the combined approach demonstrated more repigmentation. The predominant repigmentation patterns were peripheral and perifollicular, with better results in lesions on the trunk and upper extremities. Microneedling combined with NB-UVB phototherapy appears to be a safe and well-tolerated therapeutic option that may enhance repigmentation compared to NB-UVB alone. The novel findings of the study are related to

the repigmentation pattern and anatomical response differences. Both microneedling and NB-UVB phototherapy may be used independently, but their combination demonstrated significant clinical improvement, particularly for lesions on the upper extremities and trunk. The predominant patterns of repigmentation observed were peripheral and perifollicular, which are consistent with the

known mechanisms of NB-UVB-induced melanocyte migration and proliferation. Using microneedling combined with NB-UVB phototherapy for vitiligo in the upper extremities should be considered an important practical clinical implication in dermatological practice. However, a longer follow-up is required to evaluate the long-term durability of repigmentation and relapse rates.

References

1. Attwa EM, Khashaba SA, Ezzat NA. Evaluation of the additional effect of topical 5-fluorouracil to needling in the treatment of localized vitiligo. *J Cosmet Dermatol.* 2020;19:1473–8.
2. Retamal C, Hartmann D, Valenzuela F. Vitiligo: a review of pathogenesis and treatments, including new therapies on the horizon. *J Cutan Med Surg.* 2025;29:NP21–33.
3. Feng Y, Lu Y. Advances in vitiligo: update on therapeutic targets. *Front Immunol.* 2022;13:986918.
4. Esmat S, Assaf MI, Mohye Eldeen R, Gawdat HI, Saadi DG. Evaluation of needling/microneedling as an adjunct to phototherapy in the treatment of stable acral vitiligo: a comparative clinical and immunohistochemical study. *J Dermatol Treat.* 2022;33:2621–8.
5. Kubelis-López DE, Zapata-Salazar NA, Said-Fernández SL, Sánchez-Domínguez CN, Salinas-Santander MA, Martínez-Rodríguez HG, et al. Updates and new medical treatments for vitiligo (review). *Exp Ther Med.* 2021;22:797.
6. Nazmy NN, Sorour NE, Abdullah EAI, Ibrahim SE. Microneedling combined with different topically applied medications in treatment of vitiligo patients. *Postepy Dermatol Alergol.* 2025;42:606–14.
7. El-Domyati M, Anbar TS, Yehia M, Abdel-Aziz RTA. The use of intralesional corticosteroid combined with narrowband ultraviolet B in vitiligo treatment: clinical, histopathologic, and histometric evaluation. *Int J Dermatol.* 2022;61:582–90.
8. Maaddawi HA, Aljuaid AA, Alamri AM, Alghowairi DH, Bawazeer AS. The efficacy and safety of microneedling combined with tacrolimus versus tacrolimus monotherapy for vitiligo treatment: a systematic review and meta-analysis. *Dermatol Rep.* 2025;17:10166.
9. Elshafy Khashaba SA, Elkot RA, Ibrahim AM. Efficacy of NB-UVB, microneedling with triamcinolone acetonide, and a combination of both modalities in the treatment of vitiligo: a comparative study. *J Am Acad Dermatol.* 2018;79:365–7.
10. Zhu B, Liu C, Zhang L, Wang J, Chen M, Wei Y. Comparison of NB-UVB combination therapy regimens for vitiligo: a systematic review and network meta-analysis. *J Cosmet Dermatol.* 2023;22:1083–98.
11. Shin J, Lee JS, Hann SK, Oh SH. Combination treatment by 10 600 nm ablative fractional carbon dioxide laser and narrowband ultraviolet B in refractory non-segmental vitiligo: a prospective, randomized half-body comparative study. *Br J Dermatol.* 2012;166:658–61.
12. Eşme P, Gür Aksoy G, Elçin G. No additional benefit of combining fractional carbon dioxide laser with narrow-band ultraviolet B phototherapy for vitiligo: a randomized prospective study with half-body side comparison. *Dermatol Surg.* 2019;45:1627–34.
13. Kim WI, Kim S, Lee SH, Cho MK. The efficacy of fractional carbon dioxide laser combined with narrow-band ultraviolet B phototherapy for non-segmental vitiligo: a systematic review and meta-analysis. *Lasers Med Sci.* 2021;36:165–73.
14. Khullar G, Kanwar AJ, Singh S, Parsad D. Comparison of efficacy and safety profile of topical calcipotriol ointment in combination with NB-UVB vs. NB-UVB alone in the treatment of vitiligo: a 24-week prospective right-left comparative clinical trial. *J Eur Acad Dermatol Venereol.* 2015;29:925–32.