Microneedling Mask for Skin Rejuvenation

Watcharakorn Rattanakan, Anita Tangathajinda and Jitlada Meephansan*

Chulabhorn International College of Medicine, Thammasat University, Pathum Thani, Thailand
*Corresponding author, E-mail: kae_mdcu@yahoo.com

Abstract

This study evaluates the effectiveness of the microneedling mask, a novel skin rejuvenation treatment. Microneedling is a minimally invasive technique that promotes collagen induction and dermal remodeling, improving wrinkle depth and skin texture. A prospective study was conducted with 10 premenopausal female participants (ages 25–55) at the Dermatology Outpatient Department, Samitivej Sukhumvit Hospital, Thailand. Participants received eight biweekly microneedling treatments over 16 weeks. Skin changes were assessed using Antera 3D imaging at baseline and at weeks 4, 8, 12, and 16, and the Modified Fitzpatrick Wrinkle Scale at baseline and week 16. The Friedman test confirmed significant improvements in wrinkle depth and skin texture over time ($p < 0.05$). Wilcoxon pairwise comparisons demonstrated statistically significant improvements from week 8 (after four sessions), with no additional changes observed beyond week 12 (six sessions), suggesting a plateau effect. The findings suggest that four to six microneedling sessions provide optimal results, beyond which additional treatments yield diminishing returns. No adverse effects were reported. This study supports the microneedling mask as a safe, effective, and non-invasive skin rejuvenation method. Future research should explore long-term efficacy and treatment optimization.

Keywords**:** *microneedling, skin rejuvenation, collagen induction, wrinkle reduction, non-invasive treatment*

1. Introduction

The aging of the global population has become a widely recognized concern, with skin aging emerging as a multifactorial process influenced by intrinsic and extrinsic factors. Among these, chronic exposure to environmental elements, primarily ultraviolet (UV) radiation, plays a critical role in accelerating the degradation of skin components such as collagen and elastic fibers, leading to wrinkle formation, loss of subcutaneous fat, and decreased skin moisture (Hong et al., 2018; McCrudden et al., 2015) These age-related changes have fueled continuous demand for skin rejuvenation techniques that are minimally invasive and require minimal downtime. However, the efficacy of many topical treatments is limited due to the stratum corneum, which serves as a primary barrier to active compound penetration (Pruettijarai et al., 2022).

Microneedling has emerged as a promising dermatological technique that facilitates skin rejuvenation by inducing controlled micro-injuries through the stratum corneum that extend into the dermis while preserving epidermal integrity. This process stimulates fibroblast proliferation and neocollagenesis, leading to improved skin texture and elasticity with minimal risk of scarring. (Liebl, & Kloth, 2012) Additionally, microneedling enhances vascularization by inducing angiogenesis, which plays a crucial role in wound healing. The controlled microtrauma inflicted by the microneedles triggers intradermal bleeding and activates growth factors such as vascular endothelial growth factor (VEGF) (Bao et al., 2009) and transforming growth factor-beta (TGF-β), essential for cell differentiation and tissue remodeling. The process also modulates TGF-β signaling, favoring the expression of TGF-β3, which facilitates scarless collagen synthesis and long-term dermal rejuvenation (Ranamukhaarachchi et al., 2015; Russel, & Clark, 2023).

In considering these advantages, I study the efficacy of a newly developed microneedling mask for skin rejuvenation. This innovative patch was developed by the National Nanotechnology Center, Thailand. The microneedling mask is designed to offer a cost-effective, minimally invasive, and convenient alternative to traditional skin treatments, enabling enhanced transdermal delivery and collagen stimulation with reduced downtime.

This paper explores the underlying mechanisms of microneedling mask, its impact on collagen induction, and its potential as an innovative dermatological solution for effective and non-invasive skin rejuvenation.

2. Objectives

To examine the effectiveness and safety of microneedle mask on a subject's facial skin for skin rejuvenation

3. Materials and Methods

This study was conducted from September 2024 to January 2025 at the Dermatology Outpatient Department, Samitivej Sukhumvit Hospital, Thailand. A total of 10 premenopausal female participants, aged 25 to 55 years, with a score greater than Class 1 on the Modified Fitzpatrick Wrinkle Scale were enrolled.

Exclusion criteria included individuals with menopause, current tobacco use, extensive tattoos over the treatment area, outdoor occupations with high sun exposure, or pre-existing skin conditions such as atopic dermatitis, herpes simplex, hypertrophic scars, eczema, or sunburn. Participants with a history of adverse reactions to polymethyl methacrylate (PMMA) or recent dermatologic procedures were also excluded. These procedures included neuromodulator treatment (Botulinum toxin) within six months**,** filler injections in the nasolabial fold or periorbital area within two weeks**,** mesotherapy injections within one month**,** biostimulator injections within six months**,** energy-based device treatments within one year**,** and laser or skin resurfacing procedures within one month**.**

Additionally, participants with photosensitivity disorders (e.g., porphyria, lupus erythematosus, rosacea, or solar urticaria), bleeding disorders, or those currently taking anticoagulants or vitamin A derivatives were excluded. Pregnant or lactating individuals were also ineligible for participation. Only participants meeting all inclusion and exclusion criteria were enrolled in the study.

The microneedling mask, developed by the National Nanotechnology Center, Thailand, features biocompatible polymethyl methacrylate (PMMA) microneedles for effective transdermal delivery. The nonwoven fabric patch ensures stability and comfort, with biocompatibility testing confirming no cytotoxicity, skin irritation, or allergic reactions. Additionally, the mask complies with ISO 13485:2016 quality standards, ensuring safety, reliability, and efficacy in medical applications.

Participants applied the microneedling mask to the entire face under the supervision of the investigating physician. The microneedling mask was applied every two weeks, totaling eight treatment sessions throughout the study period, with each session lasting 10 minutes per application.

All participants followed a standardized skincare regimen, including a facial cleanser, moisturizer, and sunscreen (SPF >30, PA+++), provided by the study to ensure consistency and minimize external influences on skin condition.

The effectiveness of the treatment was evaluated using digital photography captured at week 0 (baseline) and week 16 to assess changes in the Modified Fitzpatrick Wrinkle Scale for grading wrinkle severity. Antera 3D imaging was used to analyze skin texture roughness (2.0 mm) and wrinkle depth (2.0 mm), specifically in the midface and forehead regions. Participants were followed up by the investigating physician every four weeks, with assessments conducted at baseline and four subsequent time points (week 0, week 4, week 8, week 12, and week 16).

For result analysis, statistical analysis was performed using the Friedman test and Wilcoxon signed-rank test, with p-values <0.05 considered statistically significant.

4. Results and Discussion

4.1 Results

Participant Characteristics

A total of ten participants were enrolled in this study. The median age (interquartile range, IQR) was 29.0 years (28.0, 32.3). Each participant underwent five treatment sessions using the microneedling mask, with assessments conducted at baseline (Time 1) and four subsequent follow-ups (Time 2 to Time 5). The

primary efficacy endpoints included wrinkle depth and skin texture, which were analyzed to evaluate the effectiveness of the intervention over time.

Efficacy Endpoints

Baseline measurements were recorded across different facial regions, and statistical analyses were conducted to assess changes over time. The Friedman test was performed to evaluate the overall progression, while Wilcoxon signed- rank tests were used for pairwise comparisons to determine the significance of improvements.

The Friedman test results indicated a statistically significant change across all five time points for multiple facial positions, suggesting an overall improvement in skin texture roughness (2.0 mm) and wrinkle depth (2.0 mm) (Table 1).

Table 1 Improvement in skin texture and wrinkle depth assessed by Antera 3D

Position	Measurement (n=10)	p-value
Mid-cheek Wrinkle	10	<0.05
Forehead Wrinkle	10	<0.05
Mid-cheek Texture	10	<0.05
Forehead Texture	10	<0.05

The change in mid-cheek texture (A) and wrinkle (B) improvement assessed by Antera 3D compared with baseline is shown in **Figure 1**, and the change in forehead texture (A) and wrinkle (B) improvement assessed by Antera 3D compared with baseline is shown in Figure 2.

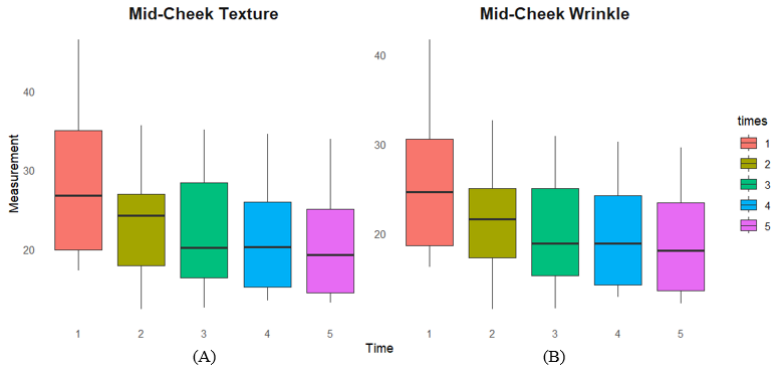

Figure 1 The change in mid-cheek texture (A) and wrinkle (B) improvement assessed by Antera 3D compared with baseline

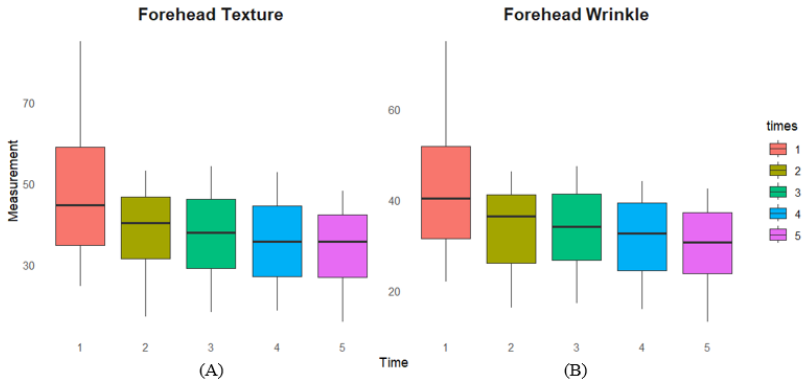

Figure 2 The change in forehead texture (A) and wrinkle (B) improvement assessed by Antera 3D compared with baseline.

To further explore the time-dependent effects, Wilcoxon pairwise comparisons were conducted, as summarized in Table 2. Significant differences were observed from Time 3 onward, indicating that at least three sessions were required to achieve visible improvements.

Table 2 The time-dependent effects

Comparison	Wilcoxon W	p-value	Adjusted p (Bonferroni)
Time 1 vs. Time 3	55	0.002	0.02
Time 1 vs. Time 4	55	0.002	0.02
Time 1 vs. Time 5	55	0.002	0.02
Time 1 vs. Time 2	47.5	0.047	0.467
Time 2 vs. Time 5	47.5	0.047	0.467
Time 3 vs. Time 5	55	0.002	0.02
Time 2 vs. Time 4	38	0.322	1
Time 4 vs. Time 5	42	0.16	1

The results indicate that significant improvements were observed after Time 3 (4 treatment sessions), with no major additional changes detected between Time 4 and Time 5.

Additionally, the Wilcoxon signed-rank test was performed to compare the Modified Fitzpatrick Wrinkle Scale scores between Time 1 and Time 5. The results did not reach statistical significance ($p = 0.08897$), as shown in Table 3.

Table 3 Wilcoxon signed-rank test results

Statistic	Value
Test Type	Wilcoxon Signed-Rank Test
Sample Size (n)	10
Test Statistic (V)	10
p-value	0.08897
Effect Size (r)	0.182

To visually demonstrate the effects of the microneedling mask, Figure 1 presents representative images of participants at baseline (Time 1) and after 16 weeks (Time 5). The images illustrate noticeable improvements in wrinkle depth and skin texture (Figure 3).

Figure 3 Representative images of a participant at (A) baseline (Time 1) and (B) after 16 weeks (Time 5) following 8 treatment sessions with the microneedling mask.

4.2 Discussion

Microneedling has emerged as a promising anti-aging intervention by stimulating collagen production, fibroblast proliferation, and dermal remodeling, leading to improved skin elasticity and reduced wrinkle depth (Yadav, & Singh, 2016). This study supports these mechanisms, as significant improvements in wrinkle depth and skin texture were observed following four treatment sessions with the microneedling mask.

The Friedman test confirmed statistically significant improvements over time ($p < 0.05$), demonstrating the effectiveness of repeated microneedling treatments. Wilcoxon pairwise comparisons further revealed that significant improvements first appeared at week 8 (Time 3), following four microneedling sessions, confirming that at least four treatments are needed for visible clinical benefits. These findings align with previous studies showing that three or more microneedling sessions resulted in significant dermal thickening and visible wrinkle reduction, outperforming single-session treatments (Aust et al., 2008; Yadav, & Singh, 2016)

A plateau effect was observed beyond six sessions, as no statistically significant differences were detected between Time 4 (week 12) and Time 5 (week 16). This suggests that four to six treatments may be optimal, as additional procedures beyond this threshold did not yield further clinical improvements. This aligns with prior research indicating that collagen remodeling peaks after multiple microneedling sessions, reaching extracellular matrix homeostasis, where further stimulation does not enhance collagen production (Ramaut et al., 2018; Sasaki, 2017).

A notable discrepancy was observed between objective and subjective assessments. While Antera 3D imaging confirmed significant improvements, the Modified Fitzpatrick Wrinkle Scale did not reach statistical significance ($p = 0.08897$). This suggests that subjective clinical grading scales may be less sensitive in detecting subtle changes in skin texture, particularly in early-stage treatments. Prior research has also emphasized that objective imaging techniques offer superior accuracy in assessing microstructural changes compared to visual grading scales (Aust et al., 2008; Fabbrocini et al., 2010). These findings highlight the importance of incorporating standardized imaging tools in future microneedling research.

The safety profile of the microneedling mask was confirmed in this study, as only transient erythema was observed, resolving within a few hours, with no serious adverse effects reported throughout the 16-week period. Previous studies have shown that microneedling carries a lower risk of complications such as erythema, edema, and post-inflammatory hyperpigmentation compared to more invasive treatments like laser resurfacing and chemical peels (Aust et al., 2008; Yadav, & Singh, 2016). Additionally, microneedling is associated with minimal downtime and high patient tolerability, making it a well-tolerated and effective skin rejuvenation approach (El-Domyati et al., 2015; Fabbrocini et al., 2010).

Microneedling offers comparable efficacy with a more favorable safety profile. While fractional CO_2 laser is highly effective for acne scars, it carries a significantly higher risk of post-inflammatory hyperpigmentation (PIH) (10% vs. 1.7%) and requires longer downtime due to prolonged erythema (Patil, & Gokhale, 2025). Similarly, chemical peels, including salicylic acid and glycolic acid peels, may cause irritation and scarring, particularly in sensitive skin, whereas microneedling has shown superior safety in comparative studies. Additionally, microneedling can be combined with platelet-rich plasma (PRP) to enhance results, making it a practical and accessible skin rejuvenation option (Dogra et al., 2014). Studies also suggest that microneedling is generally more effective than 35% glycolic acid peels for acne scars and is safe for most skin types with minimal downtime, whereas chemical peels often require longer recovery and pose a higher risk of hyperpigmentation in darker skin tones (Ishfaq et al., 2022).

Despite promising results, this study has several limitations. The small sample size ($n = 10$) limits the generalizability of findings to a broader population. Additionally, the study period was limited to 16 weeks, and long-term effects remain unknown. The lack of a control group also prevents definitive conclusions regarding whether observed improvements were solely due to microneedling or influenced by external factors like skincare adherence. Future research should incorporate randomized controlled trials (RCTs), larger sample sizes, and extended follow-up periods to further validate the efficacy and long-term safety of microneedling masks.

5. Conclusion

In this study the microneedling mask significantly improves wrinkle depth and skin texture, particularly in the midface and forehead. At least four sessions are needed for visible results, with continued benefits up to six sessions before reaching a plateau. Objective Antera 3D imaging confirmed these improvements, while the Modified Fitzpatrick Wrinkle Scale did not reach statistical significance, underscoring the limitations of subjective grading methods.

Moreover, the microneedling mask exhibited a favorable safety profile, with no reported serious adverse effects, reinforcing its role as a minimally invasive and well-tolerated skin rejuvenation procedure. Compared to other skin rejuvenation treatments such as fractional CO_2 laser and chemical peels, microneedling offers a lower risk of complications and shorter downtime.

6. Acknowledgements

The author would like to thank all staff at the Department of Dermatology, CICM, for their guidance and consultation throughout this research.

7. References

Aust, M. C., Fernandes, D., Kolokythas, P., Kaplan, H. M., & Vogt, P. M. (2008). Percutaneous collagen induction therapy: an alternative treatment for scars, wrinkles, and skin laxity. *Plastic and reconstructive surgery*, *121*(4), 1421-1429. https://doi.org/10.1097/01.prs.0000304612.72899.02

Bao, P., Kodra, A., Tomic-Canic, M., Golinko, M. S., Ehrlich, H. P., & Brem, H. (2009). The role of vascular endothelial growth factor in wound healing. *Journal of Surgical Research*, *153*(2), 347-358. https://doi.org/10.1016/j.jss.2008.04.023

Dogra, S., Yadav, S., & Sarangal, R. (2014). Microneedling for acne scars in Asian skin type: an effective low cost treatment modality. *Journal of cosmetic dermatology*, *13*(3), 180-187. https://doi.org/10.1111/jocd.12095

El-Domyati, M., Barakat, M., Awad, S., Medhat, W., El-Fakahany, H., & Farag, H. (2015). Microneedling Therapy for Atrophic Acne Scars: An Objective Evaluation. *The Journal of clinical and aesthetic dermatology*, *8*(7), 36-42.

Fabbrocini, G., Annunziata, M. C., D′ Arco, V., De Vita, V., Lodi, G., Mauriello, M. C., ... & Monfrecola, G. (2010). Acne scars: pathogenesis, classification and treatment. *Dermatology research and practice*, *2010(*1*)*, Article 893080. https://doi.org/10.1155/2010/893080

Hong, J. Y., Ko, E. J., Choi, S. Y., Li, K., Kim, A. R., Park, J. O., & Kim, B. J. (2018). Efficacy and safety of a novel, soluble microneedle patch for the improvement of facial wrinkle. *Journal of cosmetic dermatology*, *17*(2), 235-241. https://doi.org/10.1111/jocd.12426

Ishfaq, F., Shah, R., Sharif, S., Waqas, N., Jamgochian, M., & Rao, B. (2022). A comparison of microneedling versus glycolic acid chemical peel for the treatment of acne scarring. *The Journal of Clinical and Aesthetic Dermatology*, *15*(6), 48-52.

Liebl, H., & Kloth, L. C. (2012). Skin cell proliferation stimulated by microneedles. *Journal of the American College of Clinical Wound Specialists*, *4*(1), 2-6. doi:10.1016/j.jccw.2012.11.001

McCrudden, M. T., McAlister, E., Courtenay, A. J., González-Vázquez, P., Raj Singh, T. R., & Donnelly, R. F. (2015). Microneedle applications in improving skin appearance. *Experimental dermatology*, *24*(8), 561-566. https://doi.org/10.1111/exd.12723

Patil, T. M., & Gokhale, N. R. (2025). Evaluation of Efficacy and Safety of Fractional CO2 Laser Versus Micro-Needling with Autologous Platelet-Rich Plasma in Treatment of Acne Scars – A Split Face Study. *Indian Journal of Postgraduate Dermatology*, *3*, 13-18. https://doi.org/10.25259/ijpgd_74_2024

Pruettijarai, U., Meephansan, J., Prapapan, O., Pureesrisak, P., Sirithanabadeekul, P., Tantisantisom, K., ... & Khanchaitit, P. (2022). Efficacy of a novel microneedle patch for rejuvenation of the nasolabial fold. *Skin Research and Technology*, *28*(6), 786-791. https://doi.org/10.1111/srt.13199

Ramaut, L., Hoeksema, H., Pirayesh, A., Stillaert, F., & Monstrey, S. (2018). Microneedling: Where do we stand now? A systematic review of the literature. *Journal of Plastic, Reconstructive & Aesthetic Surgery*, *71*(1), 1-14. https://doi.org/10.1016/j.bjps.2017.06.006

Ranamukhaarachchi, S. A., Schneider, T., Lehnert, S., Sprenger, L., Campbell, J. R., Mansoor, I., ... & Stoeber, B. (2016). Development and validation of an artificial mechanical skin model for the study of interactions between skin and microneedles. *Macromolecular Materials and Engineering*, *301*(3), 306-314. https://doi.org/10.1002/mame.201500320

Russel, S. M., & Clark, J. M. (2023). Periorbital rejuvenation in the clinic: A state-of-the-art review. *World Journal of Otorhinolaryngology-Head and Neck Surgery*, *9*(03), 242-248. https://doi.org/10.1002/wjo2.124

Sasaki, G. H. (2016). Micro-needling depth penetration, presence of pigment particles, and fluorescein-stained platelets: clinical usage for aesthetic concerns. *Aesthetic surgery journal*, *37*(1), 71-83. https://doi.org/10.1093/asj/sjw120

Yadav, S., & Singh, A. (2016). Microneedling: Advances and widening horizons. *Indian Dermatology Online Journal*, *7*(4). https://doi.org/10.4103/2229-5178.185468