The Efficacy of a Microneedle Patch in Stimulating Hair Growth on Individuals with Androgenetic Alopecia: A Pilot Study

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Abstract

Microneedling, which can promote neocollagenesis, neovascularization, and growth factor production in the affected area, has been shown in numerous randomized controlled trials to be a successful treatment for AGA. However, further randomized controlled trials are necessary to offer more data on the utility of microneedling, as existing evidence is minimal. The objective of this study was to evaluate the efficacy of a microneedle patch in stimulating hair growth among patients with androgenetic alopecia by comparing the amount of hair before and after treatment. All participants received microneedle patch treatment on the frontal recession for 20 minutes, once a week for a total of 12 weeks at Benchakitti Park Hospital. Subsequently, their clinical progress was monitored through digital photography at baseline, 4, 8, and 12 weeks. The assessment of hair thickness was conducted by a blinded dermatologist, and participants' satisfaction was measured using satisfaction scores on a 7-point scale. The dermatologist satisfaction scores were statistically significant at $p < 0.05$ at the 8-week and 12-week follow-ups when compared to the baseline. The participants' satisfaction scores were statistically significant at $p < 0.05$ at the 4, 8, and 12-week follow-up when compared to the baseline. The results showed clinically significant improvement in hair growth. Besides, all participants expressed satisfaction with the increase in hair growth. In conclusion, a microneedle patch is a safe supplementary treatment option for androgenetic alopecia. Randomized, double-blinded clinical trials are still needed in order to provide more information on the effective use of microneedling as well as fully evaluate its clinical efficacy.

Keywords**:** *Microneedle Patch, Androgenetic Alopecia, Hair Growth*

1. Introduction

Androgenetic alopecia (AGA) is one of the most prevalent hair conditions and is defined by the non-scarring, progressive shrinkage of hair follicles in a particular distribution pattern (Blume-Peytavi et al., 2011). AGA, sometimes referred to as male pattern hair loss (MPHL) or female pattern hair loss (FPHL), is typified by gradual terminal hair loss following puberty. The condition affects at least 80% of males and 50% of females by the time they are 70 years old. It is mostly prevalent among Caucasians, followed by Asians and African Americans, and finally Native Americans and Eskimos. The condition worsens in occurrence with age (Ho, Sood, & Zito, 2024). In 2002, the proportion of bald people in Thailand was roughly 38.25% (Pathomvanich, Pongratananukul, Thienthaworn, & Manoshai, 2002). As people age, the incidence and severity of the condition rise. Although oral finasteride and topical minoxidil are the typical treatments for AGA, their effectiveness is limited and involves adverse effects (Hirshburg et al., 2016; Suchonwanit, Thammarucha, & Leerunyakul, 2019).

Microneedling has emerged as a novel treatment option for AGA and has been demonstrated to help in the regrowth of hair. A multitude of small needles are used to create micropunctures in the skin during the minimally invasive procedure, known as microneedling (Hou, Cohen, Haimovic, & Elbuluk, 2017). Typically, the length of the needles falls between 0.5 and 2.5 mm. (Fertig, Cervantes, & Tosti, 2018). Microneedling, which can promote neocollagenesis, neovascularization, and growth factor production in the affected area, has been shown in numerous randomized controlled trials to be a successful treatment for AGA (Fertig et al., 2018) Using tiny needles to create tiny percutaneous incisions, microneedling is a minimally invasive technique that releases VEGF and platelet-derived growth factor. This strategy has been demonstrated to encourage hair regeneration by increasing Wnt3a and Wnt10b expression, hair bulge activation, and the release of growth factors during the wound healing process, including platelet-derived growth factor and epidermal growth factors (Fertig et al., 2018). These elements counteract fibrosis and encourage angiogenesis as well as wound healing. Through its influence on dermal papilla stem cell

proliferation, it has been discovered to have a positive effect as a supplementary treatment for hair loss. Orentreich originally described it in 1996 for the treatment of wrinkles and atrophic scars. In addition, the sores that are created create pathways that enhance the absorption of topical medications such as finasteride or minoxidil 5% (Jia et al., 2022). However, further randomized controlled trials are necessary to offer more data on the utility of microneedling, as the present evidence is inadequate.

2. Objectives

This study aims to evaluate the efficacy of a microneedle patch in stimulating hair growth among patients with androgenetic alopecia by comparing the amount of hair before and after treatment.

3. Materials and Methods

3.1 Study design

This was a pilot study involving a total of 8 participants with the following inclusion criteria: 1) aged between 18 and 60 years old, 2) AGA Hamilton-Norwood Stages III to IV (including Type III vertex). Subjects had to maintain normal hair length, color and style during the study, 3) Female pattern hair loss Ludwig type I-II. Exclusion criteria were patients who were not interested in participation or denied participation in the study, patients undertaking treatment for the condition before the study periods, patients receiving treatment with topical medication in the previous 6 months, those receiving treatment with systemic medication (Finasteride within 12 months, Dutasteride within 18 months), those using shampoo for hair growth stimulation (non-medicated) treatment or taking hair supplements within the previous 3 months, and any other treatment for hair growth within the previous 1 month.

The study was approved by the Human Research Ethics Committee of Thammasat University (Medicine) (MTU-EC-OO-6-241/65), and all subjects signed informed consent forms before the commencement of the study.

3.2 Study device

In this research, the researchers developed novel microneedle patch strips along the hairline on the frontal recession, which are used with a sterile gel. The depth of the needle is 900 micrometers. The density of needles is 105 needles per square centimeter.

Figure 1 Microneedle patch on the frontal recession

3.3 Study protocol

All participants received a microneedle patch on the frontal recession for 20 minutes, once a week for a total of 12 weeks at Benchakitti Park Hospital. Subsequently, their clinical progress was monitored through digital photography at baseline, 4, 8, and 12 weeks using a digital camera (Sony DSC-RX100M3), with the same settings used consistently throughout the study period.

3.4 Outcome assessment

The assessment of hair thickness was conducted by one blinded dermatologist and participants' satisfaction using 7-point satisfaction scores. The scores included: Significantly decreased hair thickness

(-3), Moderate decreased hair thickness (-2), Slightly decreased hair thickness (-1), No change in hair thickness (0), Slightly increased hair thickness (1), Moderately increased hair thickness (+2), and Significantly increased hair thickness (+3).

3.5 Statistical Analysis

The authors hypothesized that treatment with the microneedle patch for hair growth would show improvement between before and after treatment. Descriptive analysis was used for the demographic data. Clinical data analyses included a comparison of results at different study times versus the baseline. The Wilcoxon signed-rank test was carried out to compare changes in the parameters at each visit. Data were analyzed using SPSS software. P-values of <0.05 were considered statistically significant.

4. Results and Discussion

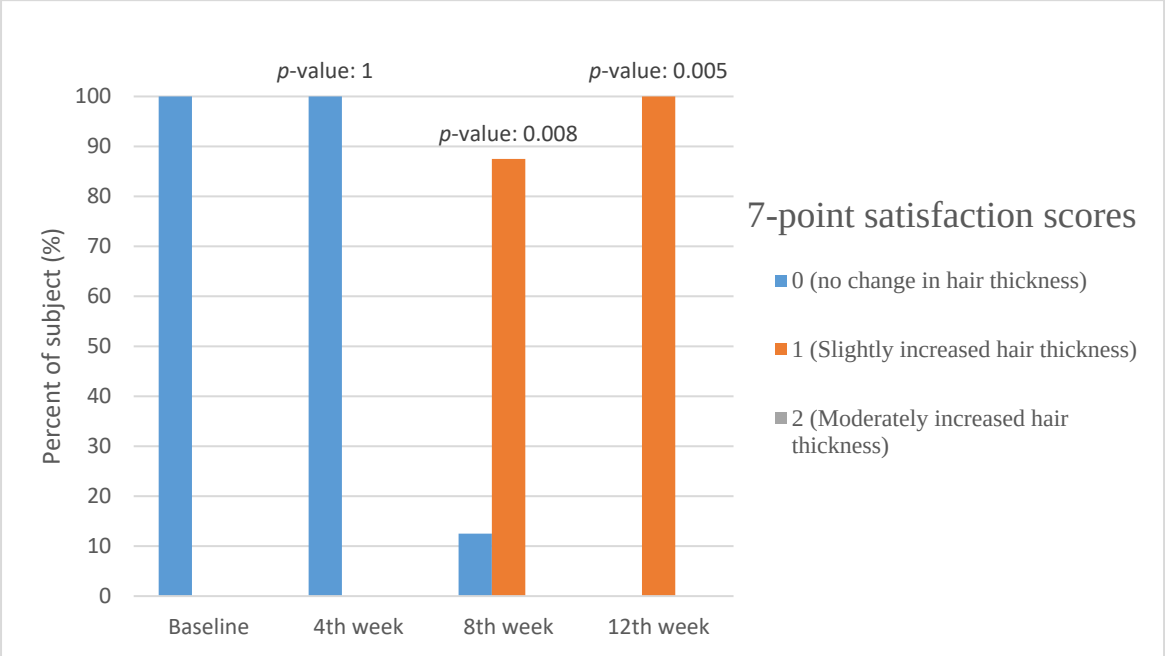
4.1 Result

In this study, 8 participants (6 female and 2 male) with the following inclusion criteria were enrolled. Most female participants were FPHL grade 2(66.7%), while most male participants had AGA grade 3 (16.7%) and grade 6 (16.7%). All 8 subjects completed the entire study. The demographic data of the subjects are described in Table 1.

The assessment of the dermatologist's 7-point satisfaction scores for hair thickness was recorded at 4-, 8-, and 12-week follow-ups, as presented in Figure 2. The scores showed that none of the subjects had any change in hair thickness at the 4-week follow-up. However, most patients showed an increase in hair thickness at the 8-week follow-up, accounting for 87.5% of the patients who scored slightly increased hair thickness. Only 12.5% of the patients showed no change in hair thickness at the 8-week follow-up. Moreover, all patients had an increase in hair thickness at the 12-week follow-up, with 100% of the patients scoring slightly increased hair thickness. The scores were statistically significant at $p < 0.05$ at the 8-week and 12-week follow-ups when compared to the baseline. The assessment of the subjects' 7-point satisfaction scores for hair thickness was recorded at 4-, 8-, and 12-week follow-ups, as presented in Figure 3. The scores revealed that most subjects had a slight change in hair thickness at the 4-week follow-up, accounting for 87.5% of the patients, meaning 12.5% of patients still showed no change in hair thickness. However, all patients exhibited an increase in hair thickness at the 8-week and 12-week follow-ups. At 8 weeks, 62.5% of the patients scored slightly increased hair thickness, while 37.5% of the patients scored moderately increased hair thickness. At 12 weeks, 25% of the patients scored slightly increased hair thickness, while 37.5% of the patients scored moderately increased hair thickness, and 37.5% of the patients scored significantly increased hair thickness. During the study, all subjects denied having any hair decrease or adverse effects from the protocol. The scores were statistically significant at $p < 0.05$ at the 4-, 8- and 12-week follow-ups when compared to the baseline.

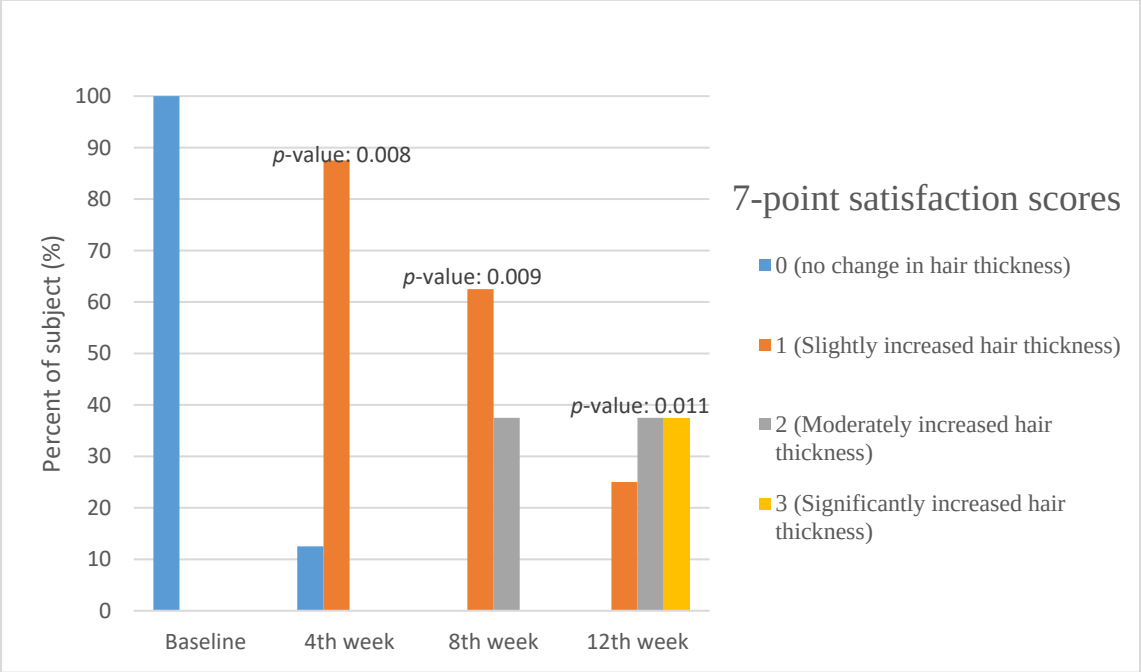
Table 1 Demographic data of subjects enrolled in the study (n= 8)

Characteristics				**Value (%) n = 8**
Age (years), mean ±SD				48.63 ± 7.23
sex	female	FPHL grade	1	2 (100%)
			2	4 (66.7%)
	male	AGA grade	3	1 (16.7%)
			6	1 (16.7%)



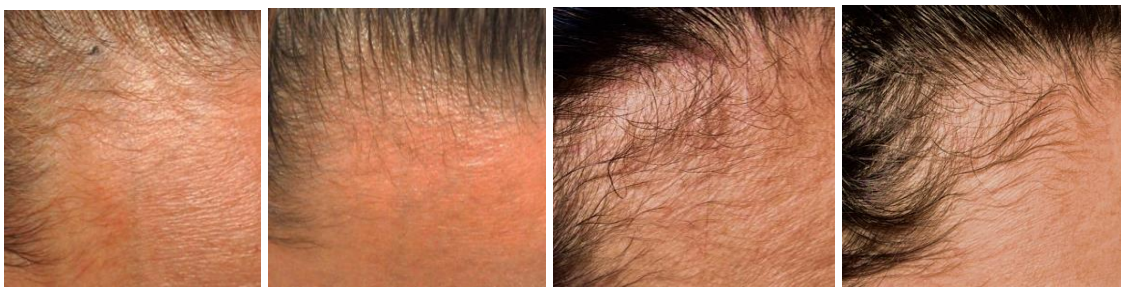
*Statistically significant at a *p*-value < 0.05 compared with the baseline

Figure 2 Dermatologist's satisfaction score



*Statistically significant at a *p*-value < 0.05 compared with the baseline

Figure 3 Subject's satisfaction score



Baseline 4-week 8-week 12-week

Figure 4 Development of hair thickness on the frontal recession using digital photography from baseline, 4-, 8- and 12-week follow-ups

4.2 Discussion

Percutaneous collagen induction, or microneedling, is a technique that promotes collagen formation and remodeling. Numerous inflammatory cytokines, including TNF-α, interleukin-1α, interleukin-8, interleukin-6, and granulocyte-macrophage colony-stimulating factor (GM-CSF), are released when the cutaneous barrier is broken, leading to vasodilation and keratinocyte migration (Ocampo-Garza et al., 2020). By enhancing Wnt3a and Wnt10b expression, hair bulge activation, and the release of growth factors during the wound healing process, such as platelet-derived growth factors and epidermal growth factors, this tactic has been shown to promote hair regeneration (Fertig et al., 2018). Microneedling may be used to treat a variety of dermatological issues, such as pigmentation disorders, actinic keratoses (AK), scarring from acne and surgery, wrinkles, stretch marks, hair pathologies like alopecia areata (AA) and AGA, and facial rejuvenation (Doddaballapur, 2009; Iriarte, Awosika, Rengifo-Pardo, & Ehrlich, 2017).

In this study, all subjects used microneedle treatment for a total of 12 sessions. Dermatologist assessment scores showed a significant increase in hair density at the 8- and 12-week follow-ups compared to the baseline. Figure 4 displays photographs of a clinical subject at baseline, 4-week, 8-week, and 12-week follow-ups, indicating noticeable hair growth and density improvement from week 4 to week 12 compared to the baseline. In self-assessments by participants, all reported an increase in frontal hair density and satisfaction with the results at the end of the study.

The results of this study suggest a microneedle patch is effective for hair regeneration. In the past, variations existed in the length of the microneedle patches as well as the frequency of their usage. This research provides a potential alternative option for utilizing a microneedle patch that has shown positive results and is convenient for AGA patients as it only requires application once a week.

The limitations of this study included its small sample size and the short duration period. To confirm the positive effects of a microneedle patch and examine any potential long-term negative effects, more research is required using a larger, randomized control trial with a more diverse population and a longer treatment duration. Additionally, other assessments should be utilized, such as the thickness of the hair and the hair count under a dermoscopy, to validate the findings of the study and reduce bias from participants' perceptions. The results of this investigation will enhance future alternatives concerning treatment for people with AGA.

5. Conclusion

In conclusion, treatment with a microneedle patch on the frontal recession has demonstrated the clinical improvement of hair growth. Thus, the conclusion can be drawn that a microneedle patch is a safe supplementary treatment for androgenetic alopecia. In the future, more research is necessary to clarify the outcomes of the microneedle patch.

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