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Application of Thulium 1927-nm Laser for Androgenic Alopecia Treatment in Indonesian Patients

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Abstract

Introduction: Androgenic alopecia (AGA) is the most prevalent form of hair loss, affecting both males and females. Current treatment modalities show varying degrees of efficacy, including high recurrence rates, potential adverse effects, and surgical trauma. The 1927-nm thulium laser has emerged as a promising alternative treatment, offering long-term benefits with good patient tolerability and minimal side effects.

Methods: A pre- and post-treatment study design was utilized to assess the efficacy of 1927-nm thulium laser therapy in ten patients with AGA. The procedure involved laser application with a pulse duration of 300 μs, power output of 5 W, and a treatment distance of 0.7 mm, performed without anesthesia. Participants underwent two treatment sessions at two-week intervals, followed by a post-treatment evaluation two weeks after the final session. The primary outcome was the Global Photographic Assessment, based on a 7-point scale evaluating standardized clinical photographs before and after treatment. The secondary outcome was patient satisfaction, measured using the Global Aesthetic Improvement Scale (GAIS). Statistical analysis was conducted using paired t-tests for parametric data and Wilcoxon signed-rank tests for non-parametric data, with a two-tailed significance threshold.

Results: A significant clinical improvement was observed at follow-ups 1 and 2 when compared to baseline, with scores (mean ± SD) of 1.10 ± 0.316 and 2.00 ± 0.471 ($P<0.05$). The patients also scored their satisfaction, which showed a significant improvement compared to baseline, with scores of 1.90 ± 0.316 and 3.00 ± 0.471 for follow-ups 1 and 2, respectively ($P<0.05$). No treatment-related adverse events were reported, and pain levels during the procedure were minimal.

Conclusion: Thulium laser therapy is safe and effective in short-term evaluation for hair regrowth in AGA patients.

Keywords: Androgenic alopecia; Hair loss; Thulium laser.

Introduction

Androgenic alopecia (AGA) is the most prevalent form of hair loss, affecting approximately 70% of males and nearly 50% of females by the age of 50.[1-4] This condition is primarily driven by androgenic hyperactivity and genetic predisposition, leading to progressive miniaturization of hair follicles and a disrupted anagen-to-telogen ratio, ultimately resulting in hair thinning and loss.[3,5] Beyond its physical manifestation, AGA negatively impacts psychological well-being, often leading to decreased self-esteem and an increased risk of mental health disorders, thereby reducing overall quality of life.[1,5]

Current treatment options for AGA include FDA-approved topical minoxidil and oral finasteride, alongside other modalities such as hair transplantation.[2,3,5,6] While these interventions show varying degrees of efficacy, they are associated with notable limitations, including high recurrence rates, adverse drug effects, and surgeries.[3,4] These challenges highlight the urgent need for alternative therapies that are both effective and well-tolerated, offering long-term benefits with minimal side effects.

The thulium laser, with a 1927-nm wavelength, is a fractional non-ablative laser that has been widely utilized in dermatology cases, particularly for skin rejuvenation and hair growth stimulation.[1,3,5,7] Its mechanism of action involves the induction of wound healing processes, enhanced circulation to hair follicles, and activation of the Wnt/β-catenin signaling pathway, which plays a crucial role in hair follicle regeneration through the release of various growth factors.[1,3,5,8] Additionally, the thulium

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laser facilitates transdermal drug delivery, improving the penetration, absorption, and retention of topical medications, further enhancing treatment outcomes when used in combination.[2,8]

Several studies have demonstrated the efficacy and safety of thulium laser therapy in promoting hair regrowth in AGA.[1,8] Clinical evidence, including a study involving 10 AGA patients, reported a significant increase in the hair count and shaft diameter following monotherapy with the thulium laser, with even greater improvements observed when combined with topical growth factors [8]. Reported adverse effects were minimal, with transient erythema, mild burning, and itching being the most common.[1,8] However, the thulium laser is a relatively new technology in Indonesia, and there is no existing evidence from the country regarding its effects on hair growth. Therefore, we aimed to provide clinical evidence on the efficacy and safety of thulium laser therapy in AGA patients from Indonesia.

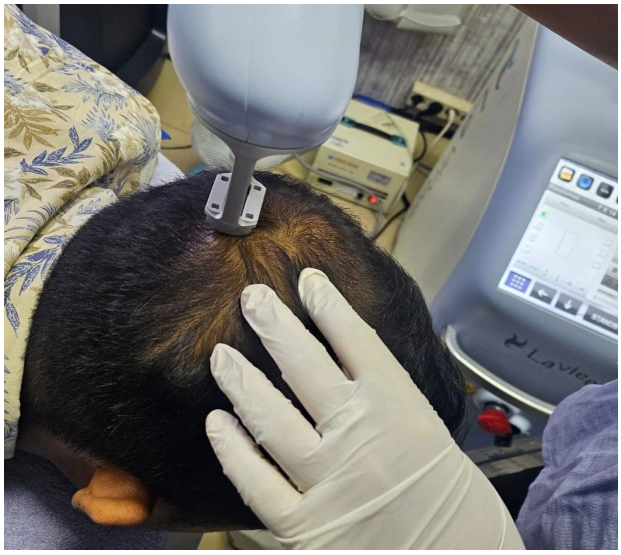

Figure 1. 1927-nm Thulium Laser Procedure. The laser was applied continuously for three to four passes until redness was observed in the scalp (duration 300 microseconds, power output 5 W, overlap 2, treatment distance 0.7 mm)

Methods

Study Design

This was a pre- and post-therapy study that compared AGA before and after thulium laser therapy. The sampling technique was purposive sampling for 3 months, resulting in 10 participants. Ten Healthy participants (5 males and 5 females) between 18 and 59 years old with AGA who agreed to participate in research by signing the informed consent, and a medical action consent form, were enrolled in this study. Exclusion criteria included pregnancy, menopausal female, history of keloid or skin malignancy, photosensitivity, immunosuppressive state, and active infection. Patients who received previous lasers, chemical peeling, filler, Botox, microdermabrasion, or other light therapy in the past 6 months were excluded.

Treatment protocol

Before the laser therapy, the scalp skin was prepared using a disinfecting agent. No topical anesthesia was used before the laser therapy. The areas of hair thinning on the scalp were treated with standardized parameters for hair regrowth in all participants. The procedure utilized a 1927-nm thulium laser (Lavieen, Wontech, South Korea), with a pulse duration of 300 μs, a power output of 5W, overlap 2 (two laser shots are given in an overlapping manner), and a treatment distance of 0.7 mm. The laser was applied continuously for 3-4 passes until slight erythema was observed (Figure 1).

The patients were scheduled for laser therapy twice at 2-week intervals, with follow-ups at 2 weeks after the first procedure (follow-up 1) and 2 weeks after the second procedure (follow-up 2). Shampooing, warm baths, and hard physical exercise were prohibited for 12 hours after the laser therapy. Application of a topical agent or administration of any medications was not permitted before the study recruitment for six months and during the course of the investigation.

Outcome evaluation

Efficacy and safety of the laser therapy were followed up 2 weeks after the final treatment.[9] The primary outcome was the global photographic assessment performed by two dermatologists who did not perform the laser procedure. The assessment was based on the interpretation of photographs before and after the treatment with the same angle using a 7-point global assessment scale (GAS): –3 = greatly decreased (-100% to -71%), –2 = moderately decreased (-70% to -41%), –1 = slightly decreased (-40% to -1%), 0 = no change, 1 = slightly increased (1% to 40%), 2 = moderately increased (41% to 70%), and 3 = greatly increased (71% to 100%).

The secondary outcome was the assessment of patients' satisfaction with the overall treatment outcome using the Global Aesthetic Improvement Scale (GAIS). The GAIS values are 0 (no change), 1 (slightly improved), 2 (improved), 3 (much improved), and 4 (very much improved). At each visit, medical examination and adverse effects related to laser treatment, including pain, erythema, erosion, oedema, seborrheic dermatitis, dryness, pruritus, and broken hair shaft, were registered at any time. The pain score was evaluated after every therapy using a visual analogue score.

Statistical Analyses

Statistical analyses were conducted using SPSS® v. 18.0 (SPSS Inc., Chicago, USA). Descriptive data were collected in the table, then an analysis was carried out to determine the normality of data distribution using the Shapiro-Wilk test. For continuous data between two

groups, a dependent *t*-test was performed for parametric distribution, while the Wilcoxon test was employed for non-parametric distribution. Statistical analyses were two-tailed. A significance level of 0.05 was employed to calculate proportions and 95 percent confidence intervals.

Results

Ten participants were involved in the study, including five males and five females, with a mean age of 37.3 ± 3.974 years, with mild to moderate AGA. All participants had previously received minoxidil solution treatment but had no history of laser therapy (Table 1).

Clinical evaluation based on the interpretation of photographs before and after therapy showed an improvement (Figures 2 and 3). A significant clinical improvement was observed at follow-ups 1 and 2 when compared to baseline (Table 2), with scores (mean ± SD) of 1.10 ± 0.316 and 2.00 ± 0.471, respectively ($P < 0.05$). The patients also scored their satisfaction that showed a significant improvement when compared to baseline (Table 3), 1.90 ± 0.316 and 3.00 ± 0.471 for follow-ups 1 and 2, respectively ($P < 0.05$).

There were no adverse effects related to laser therapy. The pain score was minimal (2-3 of 10), which resolved within 30 minutes. There was no erosion, oedema, seborrheic dermatitis, dryness, pruritus, or broken hair shaft during the evaluation.

Discussion

AGA, the most prevalent form of hair loss, remains therapeutically challenging, highlighting the urgent need for more effective alternatives.[3] Among potential candidates, the thulium laser has demonstrated promising outcomes in improving AGA, as evidenced in several studies.[1,8] In this study, we utilized thulium lasers in 10 AGA patients, with two sessions conducted at 2-week intervals, followed by evaluation at 2 weeks after the first procedure (follow-up 1) and 2 weeks after the second procedure (follow-up 2).

To evaluate clinical improvement, the global assessment scale (GAS) was employed based on standardized photographic analysis.[9] Our findings indicated a significant improvement in GAS scores at both follow-up 1 (1.10 ± 0.316, p = 0.002) and follow-up 2 (2.00 ± 0.471, p = 0.003) compared to baseline. These findings align with the findings of a study by Brownell et al, who performed the combination of thulium laser and platelet-rich plasma (PRP) in 9 males with grade II-IV AGA, showing an improvement in GAS scores at 3 and 6 months post-treatment in 89% and 67% of the patients, respectively.[1] We also noticed a significant increase in patients' satisfaction at follow-ups 1 and 2 (1.90 ± 0.316 and 3.00 ± 0.471, $P < 0.05$, respectively) compared to baseline. This is consistent with a previous study, demonstrating improvements in patients' satisfaction by 78% and 66% at 3 months and 6 months post-treatment, respectively.[1]

The thulium laser was generally well-accepted in our patients, with a minimal pain score (2-3 out of 10) resolved within 30 minutes. This was also reported in two

Table 1. Patient Demographics

Total patients	N = 10
Gender	
Female	5 (50%)
Male	5 (50%)
Mean age (min-max)	37.3 (28, 41)
Skin phototypes (I-VI)	
III	4 (40%)
IV	2 (20%)
V	4 (40%)
AGA severity	
Hamilton-Norwood IIA	1 (10%)
Hamilton-Norwood III Vertex	2 (20%)
Hamilton-Norwood VI	2 (20%)
Ludwig II	1 (10%)
Ludwig III	2 (20%)
Ludwig IV	2 (20%)
Treatment history	
Previous treatment with Minoxidil 2% Solution	5 (50%)
Previous treatment with Minoxidil 5% Solution	5 (50%)

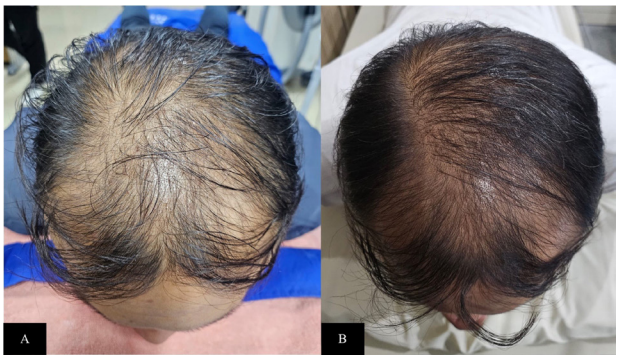

Figure 2. Male Patient With AGA: A. Before therapy, B. Two weeks after the last therapy (Follow-up 2)

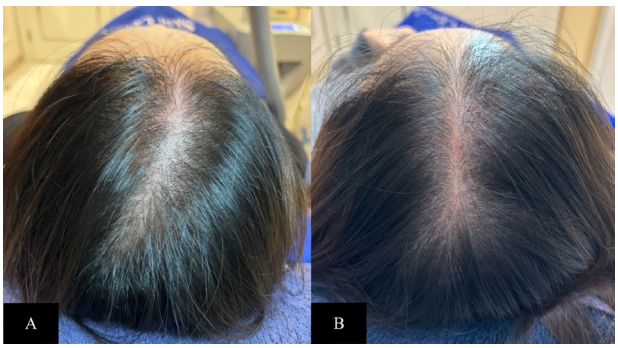

Figure 3. Female Patient With AGA: A. Before therapy, B. Two weeks after the last therapy (Follow-up 2)

Table 2. The 7-point Global Assessment Scale at baseline and follow-ups 1 and 2

7-Point GAS	Score (Mean ± SD)	*P* value (Compared with baseline)	*P* value (Compared with follow-up 1)
Baseline	0 ± 0	-	-
Follow-up 1	1.10 ± 0.316	0.002	-
Follow-up 2	2.00 ± 0.471	0.003	0.003

Abbreviation: GAS, Global Assessment Scale.

Table 3. The Global Aesthetic Improvement Scale at Baseline, 2 Weeks After the 1st Therapy, and 2 Weeks After the Last Therapy

GAIS	Score (Mean ± SD)	*P* value (Compared with baseline)	*P* value (Compared with follow-up 1)
Baseline	0 ± 0	-	-
Follow-up 1	1.90 ± 0.316	0.002	-
Follow-up 2	3.00 ± 0.471	0.003	0.002

Abbreviation: GAIS, Global Aesthetic Improvement Scale.

other studies,[1,8] showing mild pain during the treatment lasting for 1-2 days, probably due to the additional PRP injection used in the study.[1] We observed no other adverse effects such as erosion, edema, seborrheic dermatitis, dryness, pruritus, or broken hair shaft in our patients. However, transient erythema was reported in previous studies,[1,8] as well as mild itching and burning sensations, which were resolved within 1-3 days.[8] Additionally, Cho et al reported cases of seborrheic dermatitis in 6 patients, which gradually improved over time.

In terms of hair thickness and density, Cho et al conducted a prospective, single-blinded, split-scalp study involving 10 AGA patients for 12 sessions and found increased hair counts and thickness at one week, one month, and three months after the final treatment across all scalp areas ($P < 0.001$).[8] Although they noticed a gradual decrease in the hair count and thickness after 3 months, the value remained higher compared to baseline.[8] This was further confirmed by Brownell et al, who reported a significant increase in the hair mass index by 26.4% ($P = 0.024$) and a 28.1% increase in hair density ($P = 0.001$).[1]

The precise mechanism of induced hair growth following the thulium laser remains incompletely understood. Several theories have been proposed, including increased blood flow, activation of hair follicle stem cells, and upregulation of growth factors, such as vascular endothelial growth factors and keratinocyte growth factors, as demonstrated in the C3H/HeN alopecia mouse model.[10] Cho et al stated that photothermal stimulation by the thulium laser might reactivate quiescent hair follicles, supported by earlier studies indicating that repeated cutaneous injury promotes hair follicle regrowth via Wnt signaling, initiating the anagen phase.[11,12] In addition to Wnt signaling, the regeneration of the hair follicle is regulated by COL17A1,[13,14] a protein that undergoes degradation in response to DNA damage, causing follicular miniaturization as seen in AGA.[14] Preservation of COL17A1 in hair follicles facilitates the differentiation of stem cells into epidermal keratinocytes, which are thought to be the major target of the thulium laser.[8] These keratinocytes migrate to the wound created by thermal injury following the fractional laser, enabling re-epithelialization, transition of hair follicles into the anagen phase, and concurrent expression of growth factors under the control of the Wnt/β-catenin pathway.[4,11,15] Furthermore, the wound created by the thulium laser is believed to enhance drug delivery into the scalp, allowing better penetration of topical agents such as growth factors, PRP, or minoxidil. This might suggest a potential synergistic effect between the thulium laser and topical treatments, contributing to improved efficacy in AGA treatments.[1,8]

Several studies highlighted the superior safety profile of fractional lasers, including thulium lasers, in comparison to non-fractional laser treatments. Fractional lasers, when applied with appropriate wavelengths and parameters, induce micro-injuries confined to the target area, thus minimizing damage to the surrounding tissue and avoiding visible scarring. Non-ablative fractional lasers such as thulium lasers primarily target the dermis, preventing overstimulation of the hair follicle, which might result in adverse effects such as hyperpigmentation.[4] This selective and less invasive approach might be associated with improved patient tolerance, fewer complications, and shorter recovery periods. However, the therapeutic results of non-ablative lasers may not be as pronounced as those of ablative lasers such as CO_2 fractional lasers and erbium lasers.[4,15]

This is the first report of thulium laser monotherapy for AGA patients in Indonesia. On the basis of our findings, we suggest that the thulium laser might be an effective and safe treatment in promoting hair regrowth in AGA patients. However, we acknowledge certain limitations in this study. First, the measurement of hair density and thickness using trichoscopy to have a better objective evaluation was not performed in this study, which might restrict the analysis of hair regrowth quantitatively. Second, a placebo-controlled group to compare with the standard therapy was not possible in this study, which might limit the ability to draw comparative conclusions and might introduce bias in outcome interpretation. Additionally, the short follow-up period of two weeks post-treatment constrains our understanding of the long-term efficacy and durability of the intervention. Future studies involving larger numbers of participants and longer follow-up durations are needed to validate the efficacy and safety of the thulium laser in AGA. Furthermore, investigations into combination therapies, such as thulium lasers with minoxidil, PRP, or growth factors, are necessary to provide more evidence of thulium laser efficacy. As no guidelines are available

for laser parameters and treatment durations, there is a pressing need for research aiming at optimizing treatment protocols, as well as comparative studies between ablative and non-ablative fractional lasers to establish evidence-based clinical recommendations.

Conclusion

The thulium laser is effective and safe for AGA in Indonesia patients. This laser can promoting hair regrowth without significant adverse event. Further research with more objective assessments, longer evaluations, and combination with other therapeutic options would be interesting.

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Conceptualization: Putri Hendria Wardhani.
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Writing–review & editing: Putri Hendria Wardhani, Nathania Christi Putri Kinasih, Widya Kahirunnisa Sarkowi.

Competing Interests

The authors declare that they have no conflict of interests.

Ethical Approval

This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the Ethics Committee of Dr. Soetomo General Academic Hospital, Surabaya, Indonesia (Ethics approval number: 1400/KEPK/VIII/2025). Written informed consent was obtained from all participants. Participation was voluntary, and confidentiality of participants' data was strictly maintained.

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References

1. Brownell N, Panchaprateep R, Glinhom R. Combination of a non-ablative 1,927 nm thulium fiber fractional laser and autologous platelet-rich plasma in treatment of male androgenetic alopecia: a pilot study. Chula Med J. 2019;63(1):13-21. doi: 10.58837/chula.cmj.63.1.3.
2. Huang X, Zhao P, Zhang G, Su X, Li H, Gong H, et al. Application of non-pharmacologic therapy in hair loss treatment and hair regrowth. Clin Cosmet Investig Dermatol. 2024;17:1701-10. doi: 10.2147/ccid.S471754.
3. Santos Z, Avci P, Hamblin MR. Drug discovery for alopecia: gone today, hair tomorrow. Expert Opin Drug Discov. 2015;10(3):269-92. doi: 10.1517/17460441.2015.1009892.
4. Li X, Zhang S. Progress of clinical research on fractional laser treatment of androgenetic alopecia: a review article. J Cosmet Dermatol. 2024;23(11):3456-65. doi: 10.1111/jocd.16459.
5. Perper M, Aldahan AS, Fayne RA, Emerson CP, Nouri K. Efficacy of fractional lasers in treating alopecia: a literature review. Lasers Med Sci. 2017;32(8):1919-25. doi: 10.1007/s10103-017-2306-7.
6. Nestor MS, Ablon G, Gade A, Han H, Fischer DL. Treatment options for androgenetic alopecia: efficacy, side effects, compliance, financial considerations, and ethics. J Cosmet Dermatol. 2021;20(12):3759-81. doi: 10.1111/jocd.14537.
7. Cho SB, Zheng Z, Kang JS, Kim H. Therapeutic efficacy of 1,927-nm fractionated thulium laser energy and polydeoxyribonucleotide on pattern hair loss. Med Lasers. 2016;5(1):22-8. doi: 10.25289/ml.2016.5.1.22.
8. Cho SB, Goo BL, Zheng Z, Yoo KH, Kang JS, Kim H. Therapeutic efficacy and safety of a 1927-nm fractionated thulium laser on pattern hair loss: an evaluator-blinded, split-scalp study. Lasers Med Sci. 2018;33(4):851-9. doi: 10.1007/s10103-018-2437-5.
9. Wyrwich KW, Kitchen H, Knight S, Aldhouse NV, Macey J, Nunes FP, et al. The Alopecia Areata Investigator Global Assessment scale: a measure for evaluating clinically meaningful success in clinical trials. Br J Dermatol. 2020;183(4):702-9. doi: 10.1111/bjd.18883.
10. Kim WS, Lee HI, Lee JW, Lim YY, Lee SJ, Kim BJ, et al. Fractional photothermolysis laser treatment of male pattern hair loss. Dermatol Surg. 2011;37(1):41-51. doi: 10.1111/j.1524-4725.2010.01833.x.
11. Bae JM, Jung HM, Goo B, Park YM. Hair regrowth through wound healing process after ablative fractional laser treatment in a murine model. Lasers Surg Med. 2015;47(5):433-40. doi: 10.1002/lsm.22358.
12. Ito M, Yang Z, Andl T, Cui C, Kim N, Millar SE, et al. Wnt-dependent de novo hair follicle regeneration in adult mouse skin after wounding. Nature. 2007;447(7142):316-20. doi: 10.1038/nature05766.
13. Shirai K, Obara K, Tohgi N, Yamazaki A, Aki R, Hamada Y, et al. Expression of anti-aging type-XVII collagen (COL17A1/BP180) in hair follicle-associated pluripotent (HAP) stem cells during differentiation. Tissue Cell. 2019;59:33-8. doi: 10.1016/j.tice.2019.06.001.
14. Matsumura H, Mohri Y, Binh NT, Morinaga H, Fukuda M, Ito M, et al. Hair follicle aging is driven by transepidermal elimination of stem cells via COL17A1 proteolysis. Science. 2016;351(6273):aad4395. doi: 10.1126/science.aad4395.
15. Ibrahim O, Dover JS. Fundamentals of laser and light-based treatments. In: Fitzpatrick's Dermatology in General Medicine. 1st ed. New York: McGraw-Hill Education; 2019. p. 3819-33.