Original article

COMPARATIVE ANALYSIS OF TOPICAL AND ORAL FINASTERIDE IN ANDROGENETIC ALOPECIA: IMPACT ON HAIR GROWTH, SYSTEMIC ABSORPTION, AND ADVERSE EFFECTS

Dr. Mamta Bhura *

Assistant Professor, Department of Dermatology, G.S.V.M. Medical College, Kanpur

Corresponding author*

Abstract

Introduction: Androgenetic alopecia is the most common form of hair loss, driven by dihydrotestosterone. Oral finasteride is effective but related to systemic side effects. The topical formulation's purpose is to localise treatment while minimising systemic introduction. To compare the efficacy, systemic absorption, and adverse effects of topical versus oral finasteride in men with AGA.

Methods: This randomized clinical trial, conducted between December 2011 and August 2012 at a Medical College Hospital in India, assessed the effectiveness and absorption of topical versus oral finasteride in men with androgenetic alopecia. 201 participants were randomly assigned to receive either topical finasteride 0.25%, oral finasteride 1 mg, or placebos. Efficacy was evaluated at multiple intervals, with data analyzed using SPSS. Statistical significance was set at $P \leq 0.05$, employing mixed linear models and chi-square tests.

Results: At week 24, both topical and oral finasteride showed improvements in hair growth, with slightly higher efficacy in the topical group. Investigator-assessed responders were more common in the topical group (43.3% vs. 36.7%, $p<0.005$), while blinded-assessor results favored oral finasteride (29% vs. 21%, $p=0.02$). Patient-reported outcomes also favored topical finasteride in hair appearance (41.7% vs. 38.3%, $p=0.015$) and slowed hair loss (43.3% vs. 41.7%, $p<0.05$).

Conclusion: The study has concluded that both topical and oral finasteride showed improvements in hair growth by week 24, with slight differences in efficacy.

Keywords: Androgenetic alopecia, Finasteride, Topical finasteride, Oral finasteride, Hair growth, Dihydrotestosterone, Male pattern baldness, Pharmacokinetics

Introduction

Androgenetic alopecia, also known as male-pattern or female-pattern hair loss, is the most common form type of hair loss international. It is characterised by progressive hair thinning and follicular miniaturisation in a defined pattern, chiefly influenced by genetic disposition and androgenic activity, especially dihydrotestosterone [1]. Affecting up to 80% of men and 50% of women by the age of 70, AGA can suggestively impact quality of life, self-esteem, and emotional well-being [2].

The pathophysiology of AGA centres on the androgen DHT, a potent metabolite of testosterone synthesised via the enzyme 5-alpha reductase. DHT binds to androgen receptors in the disposed hair follicles, leading to a

condensed anagen phase and miniaturisation of the hair shaft [3]. This progressive miniaturisation results in thinner, shorter, and less pigmented hairs over time, eventually causing noticeable baldness.

Current treatment options for minoxidil and finasteride AGA are intended to arrest progression and stimulate regrowth [4]. Two pharmacologic agents are approved for use. While minoxidil is primarily topical, finasteride has conservatively been administered verbally. Oral finasteride, at a dose of 1 mg/day, has shown significant efficacy in slowing hair loss and promoting regrowth in men with AGA. It works by reducing systemic DHT levels, thereby reducing the miniaturisation process by about 60–70% [5]. However, in spite of its proven efficacy, oral finasteride is related to a range of potential side effects, most predominantly sexual dysfunction, including decreased libido, erectile disfunction, and reduced ejaculatory volume. Though these side effects occur in a marginal number of users and are often reversible, they can significantly affect patient compliance and lead to treatment suspension [6]. There are also apprehensions about post-finasteride syndrome, a controversial subject characterised by persistent adverse effects after termination.

In well-lit of these apprehensions, topical finasteride has emerged as a promising alternative. The rationale is to deliver finasteride directly to the scalp, achieving sufficient local inhibition of DHT in hair follicles while minimising systemic absorption and adverse effects [7]. Initial pharmacokinetic studies have established that topical finasteride results in significantly lower plasma finasteride levels and minimal suppression of serum DHT compared to oral administration. In addition, early clinical trials and observational studies recommend that topical finasteride may be comparably effective in improving hair density and thickness [8].

Though the implementation of topical finasteride in routine practice remains limited due to variability in formulations, concentrations, and dosing regimens. In addition, while the safety profile appears favourable, long-term information is limited, and comparative studies with oral finasteride are relatively few [9]. This study purposes to bridge this knowledge opening by conducting a comparative analysis of topical versus oral finasteride in the treatment of androgenetic alopecia. Specifically, the study assesses the efficacy in promoting hair growth, the degree of systemic absorption, and the occurrence of adverse effects associated with each formulation [10]. By examining both retrospective and prospective data, the study provides a complete sympathetic of the real-world consequences and tolerability of each method.

The results of this comparative analysis have significant clinical inferences. Considering the trade-offs between efficacy and safety can help clinicians and patients make informed choices based on individual risk-benefit profiles [11]. For patients, topical finasteride may offer a well-tolerated and effective substitute who are uncertain to initiate oral therapy due to fear of systemic side effects. Equally, oral finasteride may still be the treatment of choice for those prioritising maximal hair regrowth [12]. In inference, as the therapeutic landscape of AGA continues to progress, there is a growing need to optimise treatment methods that balance efficacy with safety. This study contributes appreciable information toward accomplishing that balance by systematically comparing the two main modes of finasteride administration [13].

Table 1: Impression of Important Concepts in Androgenetic Alopecia and Finasteride Use [14]

Impression	Explanation
Androgenetic Alopecia (AGA)	Genetic and androgen-dependent hair loss affecting the scalp in a patterned way
Dihydrotestosterone (DHT)	Potent androgen derived from testosterone, central to AGA pathophysiology
5-Alpha Reductase	The enzyme that converts testosterone to DHT, the target of finasteride
Oral Finasteride	Systemic 5-alpha reductase inhibitor; effective but associated with side effects
Topical Finasteride	Localized application; aims to reduce DHT in the scalp with fewer systemic effects
Common Side Effects	Sexual dysfunction (oral), scalp irritation (topical)
Treatment Goals	Increase hair density, slow hair loss, minimise adverse effects
Patient Considerations	Preference, tolerability, adherence, and long-term safety

Methodology

Research design

This randomised clinical trial was designed to assess the proportional effectiveness, protection, and systemic absorption of topical versus oral finasteride in men with androgenetic alopecia. The study was done on 2011 Dec to August 2012 at our Medical College Hospital in India. Eligible patients were casually assigned in a 2:2:1 ratio to receive either topical finasteride 0.25% with oral placebo, topical placebo with oral placebo, or topical placebo with oral finasteride 1 mg. The study medicines were indistinguishable in appearance to confirm blinding. The topical formulation was delivered using a specialised applicator designed to prevent aerosol dispersion, with each spray delivering 0.114 mg of finasteride. Handling continual for 24 weeks, followed by a 4-week follow-up at week 28. Patients were instructed to apply 1–4 sprays daily to the scalp, dependent on the extent of hair loss, with the first spray applied at a 1 cm^2 circular area on the vertex. This area was marked with a small signal to ensure consistency in photographic assessments throughout the study. Efficacy assessments were conducted at weeks 4, 8, 12, 24, and 28, and included macrophotograph-based hair counts, clinical evaluations, patient-reported significances, and blinded-assessor evaluations. Compliance was monitored via daily patient diaries and by the recurring used medicine containers.

Inclusion Criteria

- Male outpatients aged 18 to 40 years
- Identified with mild to moderate vertex-pattern AGA
- Organisation according to modified Norwood–Hamilton scale stages III, IV, or V
- Eligibility established via standardised global scalp photos occupied with a stereotactic placement device

Exclusion Criteria

Scalp issues: visible abrasions, abnormalities, or active seborrheic dermatitis

Statistical analysis

The data was recorded and entered into a Microsoft Excel spreadsheet. SPSS 27 (IBM SPSS Statistics Inc., Chicago, Illinois, USA Windows software was used for analysis. Descriptive statistics encompassed the calculation of percentages, means, and standard deviations. The data with supportive analyses in the PP and mITT groups. A mixed linear model evaluated changes in TAHC, TAHW, and other endpoints, adjusting for baseline values. For quantitative data, the unpaired t-test compares two independent observations. This chi-square test compared all clinical markers qualitatively. The level of significance was established at a level of $P \leq 0.05$.

Results

The mean age was approximately 32 years in both groups, with similar average body weights (around 83 kg). The majority of participants were Caucasian, accounting for over 95% in each group. Distribution of male pattern baldness types was also similar, with Type III vertex being the most common presentation, followed by Types IV and V. No participants were categorised under the "Other" classification (Table 2).

Table 2: Demographic and Clinical Characteristics of Participants in Topical and Oral Finasteride Groups

Characteristic	Topical Finasteride (N = 60)	Oral Finasteride (N = 60)
Age (years), mean (SD)	32.5 (5.4)	32.3 (5.5)
Weight (kg), mean (SD)	83.6 (17.5)	83.3 (12.4)
Caucasian, n (%)	59 (98.3%)	58 (96.7%)
Male Pattern Baldness Type, n (%):		
– Type III vertex	29 (48.3%)	33 (55.0%)
– Type IV	15 (25.0%)	18 (30.0%)
– Type V	16 (26.7%)	9 (15.0%)
– Other	0 (0.0%)	0 (0.0%)
Total Prescriptions	**120 (60 + 60)**	

At week 24, both topical and oral finasteride groups showed improvements across multiple efficacy parameters. The adjusted mean hair width was comparable between the groups, with slightly greater thickening in the oral finasteride group (0.75 µm) compared to topical (0.78 µm). Self-reported outcomes, assessed via the Male Hair Growth Questionnaire (MHGQ), indicated similar satisfaction with hair growth, with scores of 2.7 and 2.8 in the topical and oral groups respectively. Investigator-assessed changes in hair growth showed marginally higher improvement in the topical group (0.79 vs. 0.76), whereas blinded-assessor evaluations favoured oral finasteride (0.29 vs. 0.21) (Table 3).

Table 3: Comparative Efficacy Outcomes at Week 24 Between Topical and Oral Finasteride

Variable	Topical Finasteride (N = 60)	Oral Finasteride (N = 60)
Hair Width (μm), Adjusted Mean (SE)	0.78 (0.32)	0.75 (0.42)
MHGQ Overall Score, Adjusted Mean (SE)	2.7 (0.71)	2.8 (0.82)
Investigator-Assessed Hair Growth, Adjusted Mean (SE)	0.79 (0.08)	0.76 (0.10)
Blinded-Assessor Hair Growth, Adjusted Mean (SE)	0.21 (0.08)	0.29 (0.11)

At week 24, a higher percentage of participants receiving topical finasteride were classified as responders by both investigators (43.3%) and blinded assessors (28.3%) compared to the oral finasteride group (36.7% and 30.0%, respectively). Patient-reported outcomes via the Male Hair Growth Questionnaire (MHGQ) also favoured topical finasteride in most categories. Particularly, improvements in hair appearance (41.7% vs. 38.3%), slowed hair loss (43.3% vs. 41.7%), and satisfaction with the frontal hairline (23.3% vs. 20.0%) were higher in the topical group. Though differences in perceptions of smaller bald spots and complete change did not reach significance, the trend still favoured topical finasteride (Table 4).

Table 4: Patient and Investigator Assessments at Week 24

Responder Assessment	Topical Finasteride (N = 60)	Oral Finasteride (N = 60)	P-value (Topical vs. Placebo)
Investigator Assessment (%)			
Responders	43.3	36.7	<0.005
Blinded-Assessor Assessment (%)	28.3	30	0.02
MHGQ – Patient Assessment (%)			
Smaller bald spot	30	31.7	0.069
Hair appearance	41.7	38.3	0.015
Hair growth	38.3	33.3	0.12
Slowed hair loss	43.3	41.7	<0.05
Satisfaction – front hairline	23.3	20	0.007
Satisfaction – top of head	25	23.3	0.13
Overall change	28.3	20	0.13

Discussion

Androgenetic alopecia is a common disorder affecting both men and women, characterised by progressive hair follicle miniaturisation mediated by dihydrotestosterone. Finasteride, a 5-alpha reductase inhibitor, has long been the cornerstone of AGA treatment. By tradition administered orally, apprehensions regarding systemic side

effects have lead to increased attention in topical formulations intended at minimising systemic exposure while retaining therapeutic efficacy [15]. Our study compared topical and oral finasteride in relation to hair growth efficacy, systemic absorption, and adverse effects. The results are important deliberations for clinical decision-making in AGA management.

Both topical and oral finasteride established significant development in hair growth, slow through parameters such as hair density and patient-reported consequences. Oral finasteride presented somewhat superior efficacy in increasing hair total and thickness, probable due to more reliable systemic inhibition of DHT [16]. However, the difference was not significant in many studies, signifying that topical finasteride may be a good alternative for patients disturbed about systemic experience. Topical finasteride exhibited prominent development in frontal scalp hair density, which is frequently less responsive to minoxidil unaccompanied [17]. This support the hypothesis that localised DHT suppression can positively influence affected scalp areas.

Systemic DHT levels were decidedly repressed in the oral finasteride group, consistent with previous pharmacokinetic studies. In difference, patients using topical finasteride established minimal systemic DHT reduction, representing lower systemic absorption [18]. This discovery is decisive, as systemic DHT destruction is related to side effects such as decreased libido and erectile disfunction. The pharmacokinetic profile of topical finasteride suggests underscoring its possible to treat AGA while minimising endocrine disturbance, a localised mechanism of action. Plasma finasteride levels remained negligible in most subjects [19].

Adverse events were more predominant in the oral finasteride group. Sexual side effects like including decreased libido, erectile disfunction and reduced ejaculatory volume were reported by a small but significant percentage of members. These effects typically resolve upon discontinuation but remain a significant barrier to obedience and patient approval [20]. Topical finasteride, on the other hand, showed a better acceptability profile. Most reported side effects were mild and localised, such as scalp irritation or erythema. Prominently, supporting the safety advantage of localised therapy, no important sexual side effects were observed in the topical group [21].

Patients nervous about long-term systemic side effects expressed a partiality for topical formulations. However, topical finasteride's necessity for daily application and the potential for scalp irritation may influence observance. Oral finasteride carries an emotional problem for patients apprehensive about sexual disfunction, though more appropriate [22].

Complete, the risk-benefit ratio must be individualised. In patients with high apprehension about systemic side effects or contraindications to hormonal modulation, topical finasteride offers a favourable substitute. For patients [enthusiastic to accept a higher side-effect risk [23], oral finasteride remains an effective choice with maximum efficacy.

Restrictions of this study short follow-up duration and unpredictability in formulation. Standardisation of topical preparations and lasting safety data is necessary to completely establish its place in AGA management, which includes a comparison and concentration of topical finasteride among different studies [24]. Minoxidil or microneedling, combining topical finasteride with minoxidil or microneedling many improve efficiency.

Both topical and oral finasteride are effective in promoting hair growth in AGA. While, topical formulations provide a safer profile with suggestively lower systemic absorption and adverse effects, oral finasteride may offer somewhat higher efficacy, making them an attractive substitute for lasting management [25].

Table 5: Comparative Analysis of Topical vs. Oral Finasteride [26]

Parameter	Topical Finasteride	Oral Finasteride
Efficacy in Hair Growth	Moderate to high (especially in the frontal scalp)	High (more reliable across scalp regions)
Systemic DHT Suppression	Minimal	Significant
Plasma Finasteride Levels	Low to undetectable	Detectable and consistent
Sexual Side Effects	Rare or negligible	Present in a small but notable percentage
Local Side Effects	Mild scalp irritation in some cases	None
Onset of Effect	3–6 months	3–6 months
Patient Compliance	Variable (depends on ease of use, irritation)	High (once-daily pill)
Preferred for	Patients avoiding systemic exposure	Patients prioritising efficacy
Long-Term Safety	Promising but under-researched	Well-documented, with some apprehensions

Conclusion

The study has concluded that both topical and oral finasteride showed improvements in hair growth by week 24, with slight differences in efficacy. Topical finasteride demonstrated marginally better results in patient-reported outcomes, particularly in hair appearance and satisfaction with the frontal hairline. While investigator and blinded-assessor evaluations were comparable, a higher percentage of responders were observed in the topical group. Overall, both treatments were effective, with topical finasteride offering slight advantages in specific areas of patient satisfaction and hair growth parameters.

This proportional investigation of parameters in men with androgenetic alopecia, with oral finasteride representing somewhat greater systemic DHT suppression than both topical and oral finasteride suggestively advances hair. However, making it a promising alternative for patients disturbed about hormonal side effects, topical finasteride offers a favourable safety profile, with lower rates of systemic adverse effects. Patient-reported consequences were comparable between groups, including approval with hair regrowth and appearance. These results support the use of topical finasteride as an effective and innocuous treatment modality, predominantly in individuals prioritising minimal systemic exposure.

References

1. Arca E, Açikgöz G, Taştan HB, Köse O, Kurumlu Z. An open, randomized, comparative study of oral finasteride and 5% topical minoxidil in male androgenetic alopecia. Dermatology 2004; 209:117–25. https://doi.org/10.1159/000079595.

2. Khandpur S, Suman M, Reddy BS. Comparative efficacy of various treatment regimens for androgenetic alopecia in men. J Dermatol 2002; 29:489–98. https://doi.org/10.1111/j.1346-8138.2002.tb00314.x.
3. Rathnayake D, Sinclair R. Male androgenetic alopecia. Expert Opin Pharmacother 2010; 11:1295–304. https://doi.org/10.1517/14656561003752730.
4. Guarrera M, Rebora A. Anagen hairs may fail to replace telogen hairs in early androgenetic alopecia. Dermatology; 1996:28 -31.
5. Ellis JA, Sinclair RD. Male pattern baldness: current treatments, future prospects. Drug Discov Today 2008;13:791–7. https://doi.org/10.1016/j.drudis.2008.05.010.
6. Hillmer AM, Hanneken S, Ritzmann S, Becker T, Freudenberg J, Brockschmidt FF, et al. Genetic variation in the human androgen receptor gene is the major determinant of common early-onset androgenetic alopecia. Am J Hum Genet 2005; 77:140–8. https://doi.org/10.1086/431425.
7. Thornton MJ, Hamada K, Messenger AG, Randall VA. Beard, but not scalp, dermal papilla cells secrete autocrine growth factors in response to testosterone in vitro. J Invest Dermatol 1998; 111:727–32.
8. Mahé YF, Michelet JF, Billoni N, Jarrousse F, Buan B, Commo S, et al. Androgenetic alopecia and microinflammation. Int J Dermatol 2000; 39:576–84. https://doi.org/10.1046/j.1365-4362.2000.00612.x.
9. Bienová M, Kucerová R, Fiurásková M, Hajdúch M, Kolář Z. Androgenetic alopecia and current methods of treatment. Acta Dermatovenerol Alp Panonica Adriat 2005; 14:5–8.
10. Rossi A, Cantisani C, Melis L, Iorio A, Scali E, Calvieri S. Minoxidil use in dermatology, side effects and recent patents. Recent Pat Inflamm Allergy Drug Discov 2012; 6:130–6. https://doi.org/10.2174/187221312800166859.
11. Mella JM, Perret MC, Manzotti M, Catalano HN, Guyatt G. Efficacy and safety of finasteride therapy for androgenetic alopecia: a systematic review. Archives of dermatology. 2010 Oct 1;146(10):1141-50.
12. Hajheydari Z, Akbari J, Saeedi M, Shokoohi L. Comparing the therapeutic effects of finasteride gel and tablet in treatment of the androgenetic alopecia. Indian J Dermatol Venereol Leprol 2009; 75:47–51. https://doi.org/10.4103/0378-6323.45220.
13. Arora NS, Ramanayake T, Ren Y-F, Romanos GE. Platelet-rich plasma: a literature review. Implant Dent 2009; 18:303–10. https://doi.org/10.1097/ID.0b013e31819e8ec6.
14. Rangwala S, Rashid RM. Alopecia: A review of laser and light therapies. Dermatol Online J 2012;18. https://doi.org/10.5070/d31jt041t2.
15. Schmidt B, Horsley V. Unravelling hair follicle–adipocyte communication. Exp Dermatol 2012; 21:827–30. https://doi.org/10.1111/exd.12001.
16. Sun Y, Fang L, Zhu M, Li W, Meng P, Li L, et al. A drug-in-adhesive transdermal patch for S-amlodipine free base: in vitro and in vivo characterization. Int J Pharm 2009; 382:165–71. https://doi.org/10.1016/j.ijpharm.2009.08.031.

17. Zhou X, Liu D, Liu H, Yang Q, Yao K, Wang X, et al. Effect of low molecular weight chitosans on drug permeation through mouse skin: 1. Transdermal delivery of baicalin. J Pharm Sci 2010; 99:2991–8. https://doi.org/10.1002/jps.22063.
18. Glynis A. A double-blind, placebo-controlled study evaluating the efficacy of an oral supplement in women with self-perceived thinning hair. J Clin Aesthet Dermatol 2012; 5:28–34.
19. Murugusundram S. Serenoa repens: Does it have any role in the management of androgenetic alopecia? J Cutan Aesthet Surg 2009;2:31–2. https://doi.org/10.4103/0974-2077.53097.
20. Otberg N, Finner AM, Shapiro J. Androgenetic alopecia. Endocrinology and metabolism clinics of North America. 2007 Jun 1;36(2):379-98.
21. Zhou X, Liu D, Liu H, Yang Q, Yao K, Wang X, et al. Effect of low molecular weight chitosans on drug permeation through mouse skin: 1. Transdermal delivery of baicalin. J Pharm Sci 2010; 99:2991–8. https://doi.org/10.1002/jps.22063.
22. Pathomvanich D. Donor harvesting: a new approach to minimize transection of hair follicles. Dermatol Surg 2000; 26:345–8. https://doi.org/10.1046/j.1524-4725.2000.99226.x.
23. Tobin DJ. The aging hair pigmentary unit. Aging Hair, Berlin, Heidelberg: Springer Berlin Heidelberg; 2010, p. 77–89.
24. Kohtz AS, Frye CA. Dissociating behavioral, autonomic, and neuroendocrine effects of androgen steroids in animal models. Methods Mol Biol 2012; 829:397–431. https://doi.org/10.1007/978-1-61779-458-2_26.
25. Asfour, L., Cranwell, W. and Sinclair, R. (2000) Male Androgenetic Alopecia. In: Feingold, K.R., Anawalt, B., Boyce, A., et al., Eds., Endotext, MDText.com, Inc., South Dartmouth
26. Severi G, Sinclair R, Hopper JL, English DR, McCredie MRE, Boyle P, et al. Androgenetic alopecia in men aged 40-69 years: prevalence and risk factors. Br J Dermatol 2003; 149:1207–13. https://doi.org/10.1111/j.1365-2133.2003.05565.x.