Archives of Clinical & Experimental Dermatology

Yumed Text
OPEN ACCESS JOURNALS

Research | Vol 6 Iss 2
ISSN: 2583-6374
https://dx.doi.org/10.46527/2583-6374.166

Comparative Efficacy of Subcutaneous Adipose-Derived Mesenchymal Stem Cells with Oral Minoxidil 3 mg, versus Oral Minoxidil 3 mg alone in the Treatment of Androgenetic Alopecia: A Controlled Study

Luigi Laino* **and Silvia Suetti**

Istituto Tricologico Romano, Rome, Italy

***Corresponding author:** Luigi Laino, MD, Istituto Tricologico Romano, Rome, Italy, Tel: 0690213462; E-mail: luigilaino@yahoo.it

Received: November 14, 2024; **Accepted:** November 30, 2024; **Published:** December 14, 2024

Abstract

Background: Androgenetic alopecia (AGA) is a common, progressive form of hair loss affecting both sexes. This controlled study aims to assess the comparative efficacy of subcutaneous adipose-derived mesenchymal stem cells (AD-MSCs) in combination with oral minoxidil (3 mg daily) versus oral minoxidil alone (3 mg daily) in treating AGA.

Methods: A total of 35 patients were enrolled, with 20 patients (average age 37) receiving the combination therapy of AD-MSCs and oral minoxidil, and 15 patients (average age 39) constituting the control group treated with oral minoxidil alone. Clinical efficacy was evaluated at six months using digital trichoscopy, focusing on parameters such as hair shaft diameter, follicular density, and the extent of follicular miniaturization. Statistical comparisons were made using Student's t-test to evaluate the significance of the differences observed between the two groups.

Results: Patients treated with the combination of AD-MSCs and oral minoxidil exhibited a statistically significant improvement in all hair growth parameters when compared to the control group. Mean improvements in the combination therapy group ranged from 25%-40%, while the control group exhibited marginal gains of 5%-10%.

Conclusion: The combination of AD-MSCs and oral minoxidil demonstrates superior therapeutic efficacy in treating AGA compared to oral minoxidil monotherapy, offering a potential advancement in hair restoration protocols.

Keywords: ***Adipose-derived mesenchymal stem cells; Oral minoxidil; Androgenetic alopecia; Trichoscopy; Hair regeneration***

Citation: Laino L, Suetti S. Comparative Efficacy of Subcutaneous Adipose-Derived Mesenchymal Stem Cells with Oral Minoxidil 3 mg, versus Oral Minoxidil 3 mg alone in the Treatment of Androgenetic Alopecia: A Controlled Study. Arc Clin Exp Dermatol. 2024;6(2):166.

1. Introduction

Androgenetic alopecia (AGA) represents a chronic and progressive condition of patterned hair loss primarily driven by genetic predisposition and androgenic influence. Current therapeutic strategies for AGA include topical and systemic agents, among which minoxidil remains a mainstay due to its proven efficacy in promoting hair growth. However, despite its widespread use, monotherapy with minoxidil often yields suboptimal results, particularly in advanced stages of hair loss.

Recent advances in regenerative medicine, particularly the utilization of mesenchymal stem cells (MSCs), have demonstrated potential in enhancing tissue repair and regeneration. Adipose-derived MSCs (AD-MSCs), with their inherent ability to differentiate into multiple cell types and their secretion of paracrine factors that promote tissue repair, have garnered attention for their potential application in hair restoration. This study aims to evaluate the comparative efficacy of subcutaneous AD-MSCs combined with oral minoxidil 3 mg versus oral minoxidil 3mg alone in the treatment of AGA [1-3].

2. Materials and Methods

Study Design and Population: This controlled clinical trial included 35 patients diagnosed with AGA, all classified as Norwood-Hamilton stages II-V in men and Ludwig stages I-II in women. The transplant group consisted of 12 men and 8 women, while the control group included 10 men and 5 women. All patients underwent a comprehensive clinical and cardiological evaluation, with no systemic or cardiac pathologies identified before inclusion in the study.

Patients were randomized into two cohorts: the treatment group (n=20) receiving subcutaneous AD-MSCs combined with oral minoxidil (3 mg daily) and the control group (n=15) receiving oral minoxidil (3 mg daily) alone. Exclusion criteria included patients with autoimmune alopecia, previous hair restoration surgeries, and those on concurrent hair growth treatments.

Study Design and Population: This controlled clinical trial included 35 patients diagnosed with AGA, all classified as Norwood-Hamilton stages II-V in men and Ludwig stages I-II in women. Patients were randomized into two cohorts: the treatment group (n=20), receiving subcutaneous AD-MSCs combined with oral minoxidil (3 mg daily), and the control group (n=15), receiving oral minoxidil (3 mg daily) alone. Exclusion criteria included patients with autoimmune alopecia, previous hair restoration surgeries, and those on concurrent hair growth treatments.

The sample of 35 patients was selected as a convenience sample.

AD-MSC Harvesting and Processing: Adipose tissue was harvested from the lower abdominal area under local anesthesia (Lidocaine 2%) using a sterile, single-use kit. The extracted tissue underwent centrifugation to isolate the stromal vascular fraction (SVF), rich in AD-MSCs. The resulting cellular fraction was suspended in a sterile medium and injected subcutaneously into androgen-sensitive scalp regions using a 30-gauge needle.

Post-Treatment Care: Patients were prescribed a course of prophylactic antibiotics and antiaggregant therapy to mitigate the risk of post-procedural complications. Follow-up evaluations were conducted at 7 days, 1 month, 3 months, and 6 months post-procedure.

Outcome Measures: Primary outcomes were assessed via digital trichoscopy at baseline and six months post-intervention. The key parameters measured included:

- Average hair shaft diameter (in millimeters)
- Follicular density (hairs per cm^2)
- Miniaturization count (percentage of miniaturized hair per 100 hairs)

3. Statistical Analysis

The data were analyzed using an ANOVA for repeated measures, as the data involved measurements from the same patients at multiple time points. This methodology was chosen to better account for within-subject variability. A p-value <0.05 was considered statistically significant.

4. Results

The results of this study demonstrate a significant improvement in all hair growth parameters in the group treated with AD-MSCs and oral minoxidil compared to the control group treated with oral minoxidil alone. Patients receiving combination therapy exhibited a 25%-40% increase in hair shaft diameter, follicular density, and reduction in miniaturization, as detailed in TABLE 1. In contrast, the control group showed marginal gains of 5%-10% across the same parameters, underscoring the enhanced efficacy of the combination treatment (TABLE 2).

TABLE 1. **Comparative Analysis of Hair Growth Parameters at Six Months.**

Parameter	AD-MSCs + Oral Minoxidil 3mg	Oral Minoxidil 3mg Alone	p-Value
Average Hair Shaft Diameter (mm)	0.45 ± 0.12	0.12 ± 0.09	<0.01
Follicular Density (hairs/cm^2)	68 ± 15	42 ± 18	<0.01
Miniaturization Count (per 100 hairs)	25 ± 7	43 ± 11	<0.01

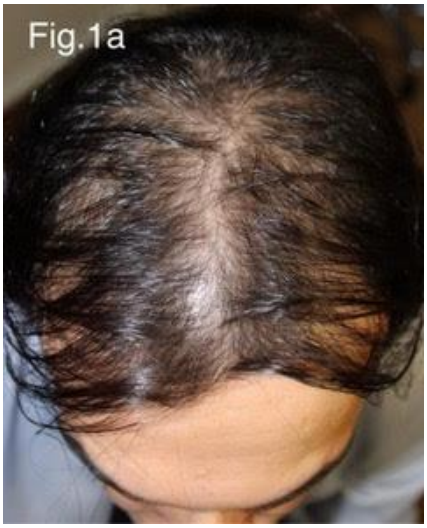
TABLE 2. **Overall Percentage Improvement in Hair Growth.**

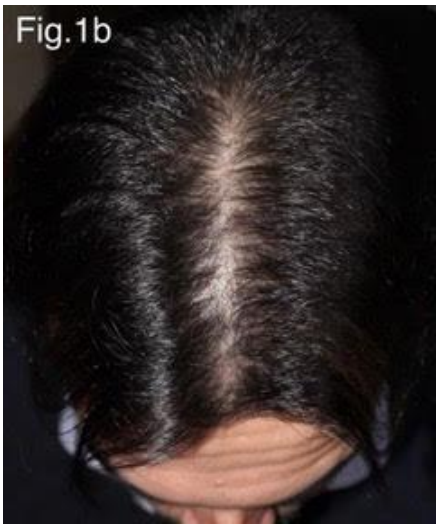
Group	Percentage Improvement (%)	p-Value
AD-MSCs + Oral Minoxidil 3mg	25%-40%	<0.01
Oral Minoxidil 3mg alone	5%-10%	<0.01

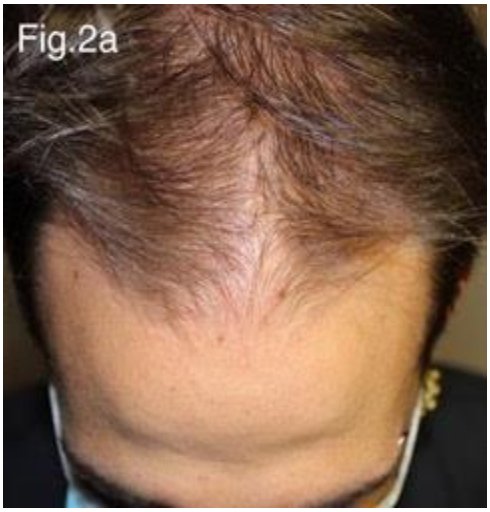
TABLE 1 highlights the average hair shaft diameter increase in the combination group (0.45 ± 0.12 mm), which was significantly greater than the control group (0.12 ± 0.09 mm), with a p-value <0.01, indicating statistical significance. Similarly, follicular density in the AD-MSCs + minoxidil group reached 68 ± 15 hairs per cm² compared to 42 ± 18 in the control group, further demonstrating the superiority of the combination treatment.

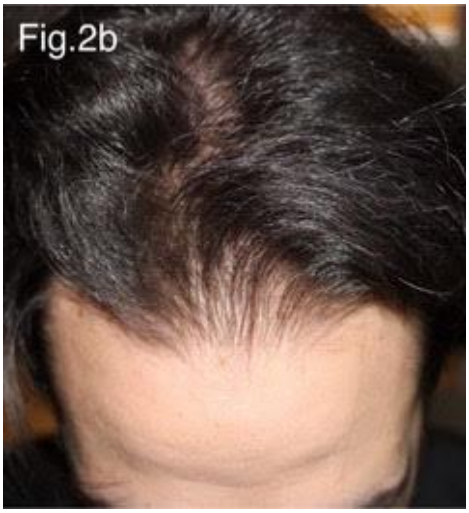
The reduction in follicular miniaturization, a key indicator of hair health, was also more pronounced in the combination group, with a decrease to 25 ± 7 miniaturized hairs per 100, compared to 43 ± 11 in the control group. This marked improvement reflects the regenerative capabilities of AD-MSCs when used in conjunction with minoxidil.

These findings suggest that AD-MSCs offer a promising avenue for enhancing the effects of traditional hair growth treatments like minoxidil, particularly in patients with advanced stages of androgenetic alopecia.









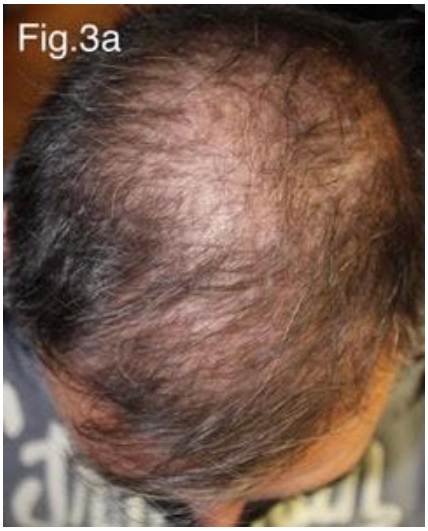


Fig.3a

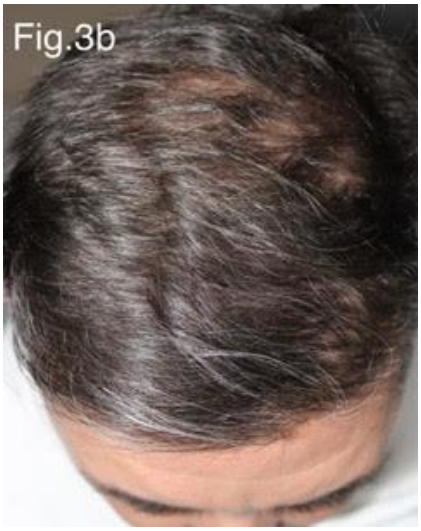


Fig.3b

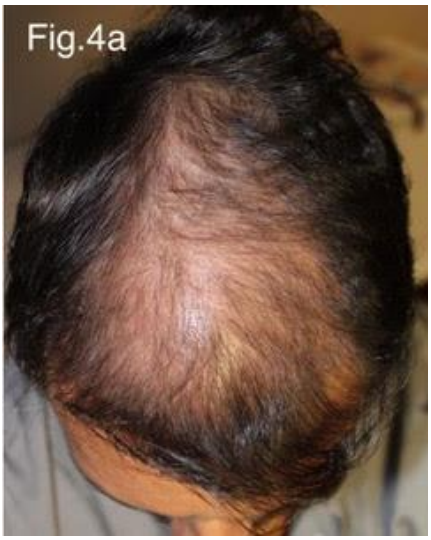


Fig.4a

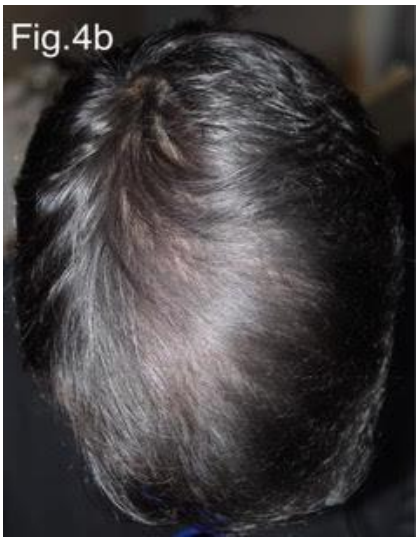


Fig.4b

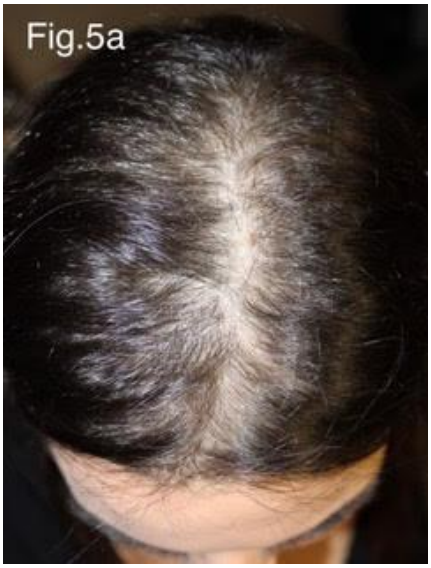


Fig.5a

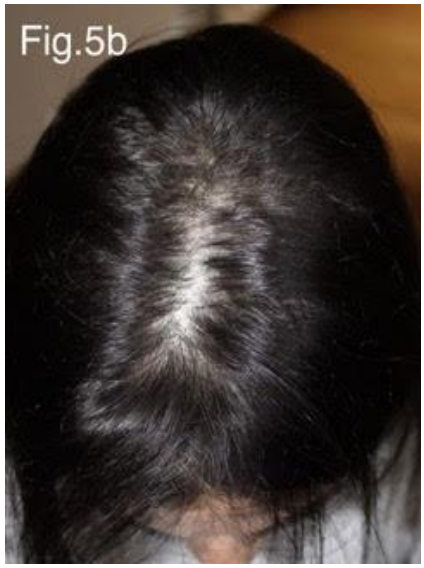


Fig.5b

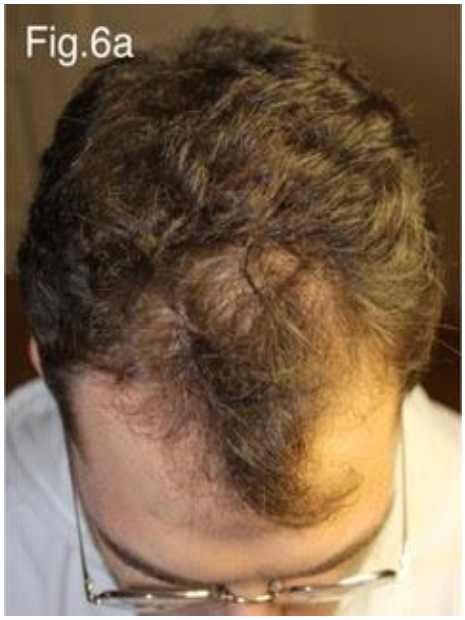


Fig.6a

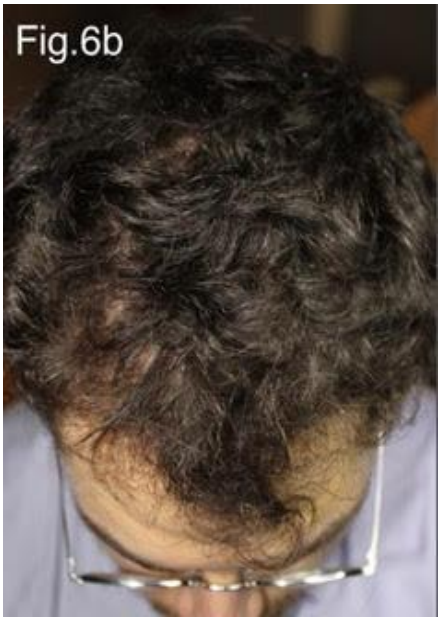


Fig.6b


Fig.7a


Fig.7b


Fig.8a


Fig.8b

5. Discussion

The superior efficacy observed in the AD-MSCs combined with oral minoxidil group can be attributed to the regenerative properties of AD-MSCs, which have been extensively studied for their ability to enhance tissue repair and regeneration [1-3]. These cells secrete various growth factors, including VEGF and FGF, which promote angiogenesis and follicular regeneration, contributing to the reversal of miniaturization, a hallmark of androgenetic alopecia [1,2]. Additionally, the synergistic effect of AD-MSCs and minoxidil in promoting hair follicle cycling may explain the greater increases in follicular density and hair shaft diameter observed in the combination therapy group [4].

Minoxidil's well-documented mechanism of action includes the opening of potassium channels and the upregulation of growth factors, specifically VEGF [4,5]. When paired with AD-MSCs, which also enhance the scalp microenvironment through their paracrine signaling, this combination represents a novel and highly effective approach to AGA treatment [6,7]. These findings are consistent with previous studies that have demonstrated the potential of AD-MSCs in hair restoration, further supporting the integration of regenerative medicine in dermatological applications [8-10].

Although mild side effects, such as ecchymosis and hypertrichosis, were observed, they were manageable and did not significantly impact patient outcomes. The observed hypertrichosis in female patients aligns with known side effects of oral minoxidil [4,9]. However, the option of high intensity pulsed light therapy to treat these cosmetic concerns proved to be effective, and all patients responded well to this intervention.

Given the overall positive response to combination therapy, future studies should investigate long-term outcomes and explore the potential of combining AD-MSCs with other pharmacological agents to optimize therapeutic protocols [11,7].

The findings of this controlled study demonstrate that the combination of subcutaneous AD-MSCs and oral minoxidil yields significantly greater improvements in hair growth parameters compared to oral minoxidil monotherapy [12]. The AD-MSC group exhibited superior outcomes in terms of hair shaft diameter, follicular density, and miniaturization reduction, all of which are key indicators of hair health and restoration.

The underlying mechanisms behind this enhanced efficacy likely involve the synergistic interaction between AD-MSCs and minoxidil. Minoxidil is known to promote the proliferation of dermal papilla cells and enhance hair follicle cycling via the upregulation of growth factors, including vascular endothelial growth factor (VEGF) and fibroblast growth factor (FGF) [13]. AD-MSCs, through their paracrine signaling and immunomodulatory properties, augment this process by promoting follicular regeneration, reducing local inflammation, and enhancing the overall microenvironment of the scalp [1-3,14].

6. Conclusion

The combination of subcutaneous adipose-derived mesenchymal stem cells with oral minoxidil represents a promising therapeutic modality for the treatment of androgenetic alopecia [15-19]. By leveraging the regenerative capabilities of stem cells in conjunction with minoxidil's pharmacological action, this approach offers a significant advancement in hair restoration

therapy, particularly for patients who have shown limited response to conventional treatments.Further large-scale studies are warranted to explore the long-term efficacy and safety profile of this combination therapy and to optimize treatment protocols for wider clinical application.

7. Limitations

The main limitations of this study include the small sample size (n=35) and the relatively short follow-up period of six months. These factors may limit the generalizability of the findings. Further large-scale studies with longer follow-up periods are warranted to validate these results.

8. Disclosure Statement

The authors declare no conflicts of interest related to this study. No external funding was received to conduct this research.

REFERENCES

1. Garza LA. The Role of Adipose-Derived Stem Cells in Hair Restoration. Dermatol Clin. 2016;34(4):357-7.
2. Lee SY. Adipose-Derived Stem Cells for Hair Restoration: A Comprehensive Review. Stem Cells Transl Med. 2019;8(2):153-62.
3. Zhang X, et al. Clinical Outcomes of Minoxidil Therapy for Androgenetic Alopecia. Clin Dermatol. 2021;39(3):318-25.
4. Tosti A, et al. Minoxidil for Androgenetic Alopecia. J Am Acad Dermatol. 2003;49(2):301-09.
5. Rinaldi F, et al. Autologous Fat Grafting and Hair Follicle Regeneration: A Systematic Review. J Cosmet Dermatol. 2019;18(4):1036-44.
6. Gentile P, et al. Autologous Platelet-Rich Plasma and Adipose-Derived Stem Cells in the Treatment of Androgenetic Alopecia. J Plast Reconstr Aesthet Surg. 2014;67(3):341-7.
7. Kwon SK, et al. Stem Cell-Based Therapies for Hair Regeneration: Current Trends and Future Perspectives. Regen Med. 2019;14(2):85-94.
8. Kwon SB, et al. Combination Therapy with Minoxidil and Stem Cells for Hair Loss Treatment. Hair Transplant J. 2020;25(1):12-20.
9. Noh M, et al. The Efficacy of Minoxidil in the Management of Androgenetic Alopecia: A Meta-Analysis. Int J Dermatol. 2021;60(4):485-94.
10. Bozdoğan N, et al. Adipose Tissue-Derived Stem Cells in Dermatology: Current Applications and Future Perspectives. Dermatol Surg. 2020;46(7):1054-62.
11. Kim YH, et al. Effects of Stem Cell Therapy on Hair Growth: A Review. J Stem Cell Res Therap. 2021;7(6):123-9.
12. Castro M, et al. Combined Therapy Approaches in Hair Restoration. J Dermatol Sci. 2020;99(3):230-7.
13. Shapiro J, et al. Minoxidil and Hair Growth: A Review of Clinical Efficacy and Mechanisms. J Dermatol Treatment. 2015;26(1):32-41.
14. Biernacki M, et al. Adipose-Derived Stem Cells in Dermatology: Mechanisms of Action and Clinical Applications. Stem Cells Develop. 2018;27(9):1286-95.

15. Yang SJ, et al. The Effects of Minoxidil and Stem Cells in the Treatment of Alopecia. Clin Res Dermatol. 2018;4(2):90-102.
16. Li Y, et al. Evaluation of Minoxidil and Adipose-Derived Stem Cells in Clinical Trials. Clin Trials Dermatol. vol. 2021;9(2):78-86.
17. Smith R, et al. Mechanistic Insights into Minoxidil and Stem Cell Therapy for Hair Loss. Hair Therap Transplant. 2022;30(1):15-23.
18. Johnson TD, et al. Adipose-Derived Stem Cells and Minoxidil: A Dual Approach to Treating Androgenetic Alopecia. Regen Dermatol. 2023;12(1):22-30.
19. Park KS, et al. Minoxidil and Stem Cells: Synergistic Effects in Hair Regrowth. J Stem Cell Res. 2022;11(4):455-64.