

Regional quantitative digital trichoscopy in female hair loss: a comparative study

Artina Pajaziti¹, Besa Gacaferi² ✉

¹Dermatovenereology Department, University Clinical Center of Kosovo, Pristina, Kosovo. ²Physiology Department, University Clinical Center of Kosovo, Pristina, Kosovo.

Abstract

Introduction: Differentiating types of hair loss in the female population is often challenging because these conditions frequently present with overlapping clinical features, especially in early or diffuse forms of hair loss. Quantitative digital trichoscopy allows objective assessment of hair and follicular parameters and may improve diagnostic accuracy. The objective of this study was to compare regional quantitative digital trichoscopic features in female patients with androgenetic alopecia (AGA) and chronic telogen effluvium (TE) under comparable clinical conditions, and to identify parameters useful for differentiating miniaturizing from non-miniaturizing alopecia.

Methods: This cross-sectional single-center study included 143 adult female patients with chronic TE ($n = 74$) and AGA ($n = 69$). Standardized digital trichoscopy was used to assess quantitative parameters in three scalp regions, followed by regional and intergroup comparisons and correlation analyses.

Results: Chronic TE demonstrated preserved trichoscopic parameters across scalp regions, whereas AGA showed region-dependent miniaturization-related changes, with the strongest discriminatory pattern observed in the frontal scalp.

Conclusions: Regional quantitative digital trichoscopy allows differentiation between common causes of female hair loss, particularly through frontal scalp assessment.

Keywords: androgenetic alopecia, hair, hair loss, telogen effluvium, trichoscopy

Received: 20 December 2025 | Returned for modification: 14 April 2026 | Accepted: 29 April 2026

Introduction

Hair loss disorders are a frequent reason for dermatologic consultation, particularly among women, in whom differentiation between non-scarring alopecias may remain challenging. Androgenetic alopecia (AGA) and telogen effluvium (TE) are among the most common causes of hair loss in adult women and may present with overlapping clinical features, especially in early or diffuse forms. Accurate distinction between these entities is essential because their pathophysiology, prognosis, and therapeutic approaches differ substantially (1–4).

Female AGA is characterized by progressive follicular miniaturization driven by genetic predisposition and androgen sensitivity, leading to gradual reduction in hair shaft diameter, increased hair diameter diversity, and altered follicular unit architecture. Clinical grading systems such as the Ludwig and Sinclair scales are widely used to assess disease severity; however, these tools rely on subjective visual assessment and may fail to detect early structural changes or subtle progression (1–3, 5, 6).

In contrast, TE is a non-scarring, non-miniaturizing alopecia defined by premature transition of hair follicles from the anagen to the telogen phase, resulting in diffuse hair shedding with preservation of follicular structure. Despite these fundamental differences, early AGA and chronic TE may appear clinically similar, complicating diagnosis in routine practice (2–4, 7, 8).

Trichoscopy has emerged as a valuable non-invasive diagnostic tool in the evaluation of hair and scalp disorders. Advances in digital trichoscopy and automated image analysis allow objective

quantification of parameters such as hair density, hair shaft thickness, follicular unit density, hair diameter diversity, and cumulative hair thickness. Quantitative trichoscopy provides reproducible numerical data that reflect underlying follicular biology, and it allows detection of miniaturization-related changes that may not be apparent on clinical examination (9–17).

Previous studies have described characteristic trichoscopic features of AGA, including increased hair diameter diversity, a higher proportion of thin hairs, and a progressive shift toward single-hair follicular units, particularly in the frontal scalp. Conversely, TE has been associated with preserved shaft thickness, low proportions of thin hairs, and stable follicular unit architecture, supporting its classification as a non-miniaturizing alopecia. However, most studies have evaluated these conditions separately or have focused on qualitative findings, with limited emphasis on direct quantitative comparison using standardized digital platforms (4, 5, 8–10, 15–18).

Furthermore, scalp hair parameters vary anatomically between regions, even in healthy individuals, with documented differences in hair density, follicular unit distribution, and regional baseline values across populations. Systematic regional quantitative comparison between female AGA and chronic TE using identical acquisition protocols remains limited (11, 16, 19–21).

The aim of this study was to perform a regional quantitative digital trichoscopic analysis in female patients with AGA and chronic TE to determine whether objective numerical differences may help distinguish these two conditions and to identify scalp regions with the greatest diagnostic value.

✉ Corresponding author: besa.gacaferi@uni-pr.edu

Methods

This was a cross-sectional, observational, single-center study conducted between January 2023 and July 2024. The study adhered to the principles of the Declaration of Helsinki and received ethical approval from the Kosovo Medical Chamber Ethics Committee (approval no. 244/2023). The study included adult female patients ≥ 18 years old with either chronic TE or AGA that had complete digital trichoscopy datasets. Written informed consent was obtained from all participants.

For the AGA group, adult female patients (≥ 18 years) with clinically diagnosed AGA were consecutively enrolled. Clinical severity was assessed using the Ludwig scale. Exclusion criteria included scarring alopecia, alopecia areata, inflammatory scalp disease, trichotillomania, prior hair transplantation, and use of systemic or topical hair-growth-modifying treatments within the preceding 6 months. All patients had normal laboratory evaluations excluding systemic causes of hair loss.

For the TE group, adult female patients (≥ 18 years) with chronic TE, defined as diffuse hair shedding lasting longer than 6 months, were included. The diagnosis was established based on clinical history, duration and pattern of shedding, clinical scalp examination, and digital trichoscopy. Patients showed diffuse shedding without patterned thinning and without trichoscopic features suggestive of follicular miniaturization, such as marked hair diameter diversity, increased proportions of thin hairs, or predominance of single-hair follicular units in a patterned distribution. Laboratory investigations were performed to exclude systemic causes of diffuse hair loss, including infectious, autoimmune, malignant, metabolic, and hormonal disorders.

No formal a priori sample size calculation was performed because this was a descriptive cross-sectional study. The sample was based on feasibility and comprised all consecutively eligible female patients with complete trichoscopic datasets during the study period.

Digital trichoscopy was performed using the FotoFinder Medicam 1000 system (FotoFinder systems, Bad Birnbach, Germany) with integrated TrichoLAB software. Diagnosis was established by clinical evaluation in conjunction with digital trichoscopy, and the automated software-generated measurements were used for standardized quantitative assessment rather than as the sole basis for diagnosis. All examinations, including image acquisition, selection of standardized scalp regions, and image quality control, were performed by the same trained dermatologist.

Patients washed their hair 48 hours prior to assessment. Images were obtained from three predefined scalp regions: frontal region, approximately 2 cm posterior to the frontal hairline along the midline; temporal region; and occipital region. Overview images were acquired at $\times 20$ magnification, and quantitative meas-

urements were obtained at $\times 50$ magnification using standardized capture fields.

The TrichoLAB software automatically generated quantitative trichoscopic parameters, including hair density, mean hair shaft thickness, proportions of thin, mid, and thick hairs, follicular unit density, follicular unit composition, cumulative hair thickness, and derived clinical severity scores. Hair diameter diversity $\geq 20\%$ was considered supportive of follicular miniaturization and was used as part of the diagnostic assessment of AGA together with clinical evaluation and digital trichoscopy findings. However, hair diameter diversity was not extracted or analyzed as a separate continuous quantitative outcome variable. The automated trichoscopic measurements were therefore primarily used for standardized regional comparison between AGA and chronic TE within a clinically supervised diagnostic workflow.

Data were analyzed using Python (v3.11). Continuous variables were expressed as mean $\pm$ standard deviation. Normality of distribution was assessed using the Shapiro–Wilk test. Intergroup comparisons between the AGA and chronic TE groups within each scalp region were performed using Welch's *t*-test for normally distributed variables and the Mann–Whitney *U* test for non-normally distributed variables. Within-group regional comparisons across the frontal, temporal, and occipital scalp regions were performed using repeated-measures ANOVA for normally distributed variables and the Friedman test when normality assumptions were not met. Pearson correlation coefficients were used to assess associations between clinical severity, age, and trichoscopic parameters. A *p*-value < 0.05 was considered statistically significant.

Results

Age distribution was comparable between groups. AGA patients were clinically graded using the Ludwig scale, and TE patients demonstrated diffuse shedding without patterned thinning (Table 1).

TE demonstrated preserved hair density, stable shaft thickness, low proportions of thin hairs, and maintained follicular unit architecture across frontal, temporal, and occipital regions.

Table 1 | Demographic and clinical characteristics of the study population.

Variable	Telogen effluvium	Androgenetic alopecia
Number of patients (female)	74	69
Age, years (mean $\pm$ SD)	31.4 $\pm$ 8.9	33.4 $\pm$ 8.2
Age range (years)	18–58	19–55
Chronic hair loss > 6 months	100%	100%
Ludwig stage I (%)	NA	38
Ludwig stage II (%)	NA	44
Ludwig stage III (%)	NA	18

NA = not applicable, SD = standard deviation.

Note. Values are presented as mean $\pm$ SD or percentage, as appropriate.

Table 2 | Regional quantitative trichoscopic parameters in chronic telogen effluvium.

Parameter	Frontal	Temporal	Occipital
Hair density (hairs/cm ²)	212.5 $\pm$ 42.9	215.7 $\pm$ 42.7	214.0 $\pm$ 29.4
Mean shaft thickness (μ m)	65.5 $\pm$ 8.3	64.7 $\pm$ 7.8	63.5 $\pm$ 7.4
Thin hairs $< 30 \mu$ m (%)	5.6 $\pm$ 3.8	5.8 $\pm$ 3.8	6.2 $\pm$ 3.8
Thick hairs $> 50 \mu$ m (%)	74.4 $\pm$ 11.0	72.9 $\pm$ 10.8	72.1 $\pm$ 10.5
Follicular unit density (units/cm ²)	103.0 $\pm$ 14.1	85.7 $\pm$ 11.8	86.2 $\pm$ 11.9
Single follicular units (%)	33.3 $\pm$ 10.0	36.3 $\pm$ 10.6	41.7 $\pm$ 8.8
Triple+ follicular units (%)	29.6 $\pm$ 11.9	27.2 $\pm$ 11.0	35.9 $\pm$ 12.8
Cumulative hair thickness (mm/cm ²)	13.7 $\pm$ 2.5	13.6 $\pm$ 2.7	11.7 $\pm$ 1.6

Note. All values are presented as mean $\pm$ standard deviation.

Minimal regional variation was observed, consistent with a non-miniaturizing profile (Table 2).

Regional trichoscopic parameters in AGA

AGA showed marked regional variation. The frontal region exhibited the most pronounced overall miniaturization-related changes, including reduced mean shaft thickness, increased proportions of thin hairs, and a predominance of single-hair follicular units. Temporal hair density was the lowest in this cohort, whereas the occipital region showed relative preservation.

Regional comparison between AGA and TE

Direct regional comparison revealed quantitative differences between AGA and TE, most prominently in the frontal region (Table 3 and 4). Significant inter-group differences in the frontal scalp were observed for hair density ($p < 0.001$), mean hair shaft thickness ($p < 0.001$), thin hairs $< 30 \mu\text{m}$ ($p < 0.001$), and cumulative hair thickness ($p < 0.001$), whereas follicular unit density did not reach statistical significance ($p = 0.051$). In the temporal region, significant differences were found for hair density ($p < 0.001$), mean shaft thickness ($p = 0.006$), thin hairs $< 30 \mu\text{m}$ ($p < 0.001$), follicular unit density ($p < 0.001$), and cumulative hair thickness ($p < 0.001$). In the occipital region, significant differences were present for hair density ($p < 0.001$), mean shaft thickness ($p = 0.047$), thin hairs $< 30 \mu\text{m}$ ($p = 0.022$), and cumulative hair thickness ($p = 0.008$), whereas follicular unit density did not differ significantly between groups ($p = 0.733$); see Figure 1.

Correlation analysis

In AGA, clinical severity correlated strongly with reduced hair density, shaft thickness, and altered follicular unit composition,

particularly frontally (Fig. 2). TE showed strong internal correlations reflecting preserved follicular structure (Table 5).

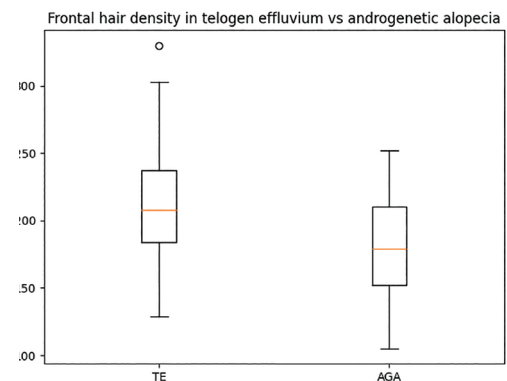


Figure 1 | Box plot showing frontal hair density (hairs/cm²) in female patients with chronic telogen effluvium (TE) and androgenetic alopecia (AGA). Patients with AGA demonstrated lower frontal hair density compared to TE ($p < 0.001$), supporting the discriminatory value of frontal scalp assessment.

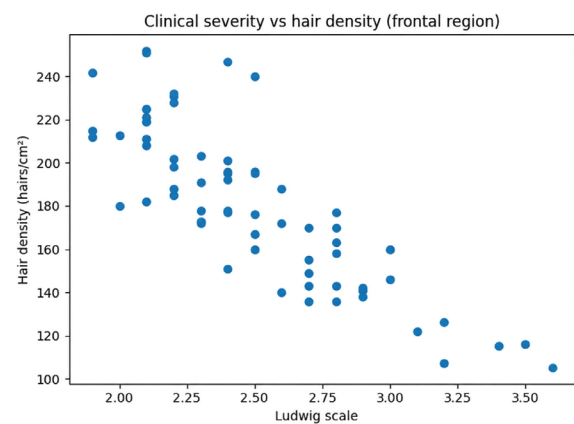


Figure 2 | Scatter plot illustrating the relationship between clinical severity (Ludwig scale) and frontal hair density (hairs/cm²) in female patients with androgenetic alopecia. Increasing clinical severity is associated with progressively reduced hair density.

Table 3 | Regional quantitative trichoscopic parameters in female androgenetic alopecia.

Parameter	Frontal	Temporal	Occipital
Hair density (hairs/cm ²)	182.1 ± 38.5	143.0 ± 31.2	186.6 ± 35.0
Mean shaft thickness (μm)	55.4 ± 6.9	60.8 ± 8.8	60.8 ± 8.6
Thin hairs $< 30 \mu\text{m}$ (%)	12.4 ± 7.1	10.6 ± 7.3	8.1 ± 5.7
Thick hairs $> 50 \mu\text{m}$ (%)	57.3 ± 14.8	66.9 ± 15.7	68.2 ± 15.1
Follicular unit density (units/cm ²)	98.4 ± 13.8	75.1 ± 14.6	85.4 ± 15.7
Single follicular units (%)	43.4 ± 11.8	38.5 ± 12.9	29.2 ± 10.0
Triple+ follicular units (%)	22.4 ± 9.7	23.9 ± 11.2	35.0 ± 12.6
Cumulative hair thickness (mm/cm ²)	10.2 ± 2.4	11.8 ± 2.6	12.6 ± 2.3

Note. Higher proportions of thin hairs and single follicular units reflect follicular miniaturization.

Table 4 | Intergroup comparison of regional trichoscopic parameters between chronic telogen effluvium (TE) and androgenetic alopecia (AGA).

Scalp region	Hair density (hairs/cm ²)	Mean shaft thickness (μm)	Thin hairs $< 30 \mu\text{m}$ (%)	Follicular unit density (units/cm ²)	Cumulative hair thickness (mm/cm ²)
Frontal					
TE	212.5 ± 42.9	65.5 ± 8.3	5.6 ± 3.8	103.0 ± 14.1	13.7 ± 2.5
AGA	182.1 ± 38.5	55.4 ± 6.9	12.4 ± 7.1	98.4 ± 13.8	10.2 ± 2.4
p-value	< 0.001	< 0.001	< 0.001	0.051	< 0.001
Temporal					
TE	215.7 ± 42.7	64.7 ± 7.8	5.8 ± 3.8	85.7 ± 11.8	13.6 ± 2.7
AGA	143.0 ± 31.2	60.8 ± 8.8	10.6 ± 7.3	75.1 ± 14.6	11.8 ± 2.6
p-value	< 0.001	0.006	< 0.001	< 0.001	< 0.001
Occipital					
TE	214.0 ± 29.4	63.5 ± 7.4	6.2 ± 3.8	86.2 ± 11.9	11.7 ± 1.6
AGA	186.6 ± 35.0	60.8 ± 8.6	8.1 ± 5.7	85.4 ± 15.7	12.6 ± 2.3
p-value	< 0.001	0.047	0.022	0.733	0.008

Note. Descriptive regional values for each diagnostic group are presented in Tables 2 and 3. This table summarizes the direct intergroup comparisons between androgenetic alopecia and chronic telogen effluvium across scalp regions, with exact p -values provided where applicable and values below 0.001 reported as $p < 0.001$.

Table 5 | Correlation between clinical severity and trichoscopic parameters in androgenetic alopecia.

Correlation pair	Frontal (<i>r</i>)	Temporal (<i>r</i>)	Occipital (<i>r</i>)
Ludwig scale ↔ Hair density	−0.81	−0.78	−0.71
Ludwig scale ↔ Shaft thickness	−0.39	−0.55	−0.49
Ludwig scale ↔ Single follicular units (%)	0.72	0.53	0.38
Ludwig scale ↔ Triple follicular units (%)	−0.70	−0.51	−0.49
Hair density ↔ Follicular unit density	0.84	0.76	0.79

Note. Pearson correlation coefficients are shown; *p* < 0.05 was considered statistically significant.

Discussion

This study provides a detailed regional quantitative digital trichoscopic comparison between female AGA and chronic TE, demonstrating clear numerical differences that correspond to their different clinical and trichoscopic patterns. By applying identical acquisition protocols and parameters across frontal, temporal, and occipital scalp regions, our findings allow direct comparison with previously published trichoscopic studies while adding a structured regional perspective.

Although some of the patients included were relatively young, this reflects the clinical presentation of women referred for evaluation of diffuse hair loss, for which both early AGA and chronic TE may occur in young adulthood. Importantly, the mean age was comparable between groups and aligned with published data on female hair loss cohorts.

Our results show that female AGA is characterized by miniaturization-related trichoscopic changes, including reduced hair density, decreased mean hair shaft thickness, increased proportions of thin hairs, and a predominance of single-hair follicular units, particularly in the frontal scalp. These findings are consistent with systematic reviews and quantitative studies describing trichoscopic hallmarks of AGA (6, 9, 10, 18). In particular, the marked increase in thin hairs and reduction in cumulative hair thickness observed in the frontal region align with the diagnostic relevance of hair diameter diversity emphasized by Park et al. (18).

Whereas most previous studies focused primarily on the frontal scalp, our study demonstrates that quantitative alterations may also extend to the temporal region, with relative preservation of the occipital region. This regional gradient supports observations reported by Kamishima et al. (6) while adding numerical comparisons across scalp regions.

Comparison with trichoscopic findings in TE

In contrast, chronic TE in our cohort showed preserved hair density, stable shaft thickness, low proportions of thin hairs, and maintained follicular unit architecture across all scalp regions. These findings are in agreement with studies describing TE as a non-miniaturizing alopecia with preserved follicular structure (2, 12, 13). Diagnostic reviews and trichoscopic evaluations have similarly shown that shaft thickness and follicular unit composition remain relatively preserved in TE, a pattern that closely mirrors our quantitative results (2, 4, 12, 13).

The minimal regional variation observed in TE supports the concept of diffuse, non-patterned involvement. This contrasts with AGA and supports the diagnostic value of regional quantitative assessment, particularly when clinical features overlap.

Direct comparison between AGA and TE

Direct regional comparison between AGA and TE revealed that the frontal region provided the greatest discriminatory value, with

significant differences in hair density, shaft thickness, thin hairs, and follicular unit composition. Although temporal hair density was lowest in this cohort, the frontal region showed the most consistent overall pattern of miniaturization-related changes across multiple quantitative parameters. These observations are consistent with the computerized trichoscopy study by Long et al. (5), which demonstrated that quantitative parameters may improve differentiation between female AGA and TE. Our study extends these findings by incorporating a structured multi-regional approach, showing that diagnostic separation is strongest frontally but remains informative temporally. Together, these findings support the clinical use of standardized regional quantitative trichoscopy as an adjunctive tool for differentiating female AGA from chronic TE, particularly when clinical features overlap.

The occipital region showed the smallest differences between groups, supporting its role as a relative reference site, as suggested by prior studies on regional scalp variation and digital mapping (16, 19, 20). However, mild quantitative changes were still detectable in some patients with AGA, suggesting that caution may be warranted when using the occipital region as a reference site in more advanced disease.

Clinical–trichoscopic correlations

The strong correlations observed between clinical severity (Ludwig scale) and trichoscopic parameters in AGA—particularly hair density, shaft thickness, and follicular unit composition—support previous reports linking clinical grading with objective follicular changes (5, 9, 21). Our findings support the role of quantitative trichoscopy as an objective adjunctive assessment tool that may complement clinical grading and improve characterization of disease severity.

In TE, internal correlations between shaft thickness and cumulative hair thickness were preserved, reflecting maintained follicular architecture. This pattern contrasts with AGA and is consistent with the distinction between miniaturizing and non-miniaturizing alopecias described in prior literature (2, 4, 12, 13).

Whereas previous studies have described trichoscopic features of AGA and TE separately, the novelty of this study lies in its direct region-by-region quantitative comparison using identical parameters and acquisition protocols in a female-only cohort. By integrating regional analysis with automated digital measurements, our study adds objective numerical data that may support more standardized assessment of women with diffuse hair loss.

The consistency of our findings with published literature supports their clinical relevance, and the regional numerical detail may help inform future multicenter studies aimed at defining standardized quantitative trichoscopic reference ranges.

Limitations

This study was cross-sectional and single-center, limiting generalizability. It included only female patients. Longitudinal data and

healthy control comparisons were not available. In addition, automated digital trichoscopy systems may have inherent measurement variability; however, this was reduced in this study by the use of a standardized acquisition protocol, the same imaging device and software platform, and consistent image capture procedures. Scalp biopsies were not performed; therefore, the diagnosis of chronic TE was based on clinical evaluation, laboratory exclusion of systemic causes, and digital trichoscopic findings. Although biopsy is not routinely required in typical cases, it may be considered

in selected diagnostically challenging cases of chronic TE.

Conclusions

Quantitative digital trichoscopy allows region-specific differentiation between female AGA and chronic TE. The frontal scalp showed the strongest discriminatory value, supporting standardized regional trichoscopic assessment as an adjunctive tool in women with diffuse hair loss.

References

- Liu Y, Tosti A, Wang ECE, Heilmann-Heimbach S, Aguh C, Jimenez F, et al. Androgenetic alopecia. *Nat Rev Dis Primers*. 2025;11:73.
- Chien Yin GO, Siong-See JL, Wang ECE. Telogen effluvium: a review of the science and current obstacles. *J Dermatol Sci*. 2021;101:156–63.
- Mubki T, Rudnicka L, Olszewska M, Shapiro J. Evaluation and diagnosis of the hair loss patient: part II. Trichoscopic and laboratory evaluations. *J Am Acad Dermatol*. 2014;71:431.e1–11.
- Khutsishvili N, Starace M, Bruni F, Piraccini BM. Trichoscopy—a valuable tool for identifying conditions mimicking androgenetic alopecia. *Int J Dermatol*. 2024;63:23–31.
- Long B, Long Q, Pan W, Chen S, Ye Z, Guo H. Trichoscopic features, clinical correlates, and risk prediction in female pattern hair loss: a retrospective case-control study. *Clin Cosmet Investig Dermatol*. 2026;19:585446.
- Kamishima T, Hirabe C, Myint KZY, Taguchi J. Divergent progression pathways in male androgenetic alopecia and female pattern hair loss: trichoscopic perspectives. *J Cosmet Dermatol*. 2024;23:1828–39.
- Tešanović Perković D, Vukojević M, Bukvić Mokos Z, Buljan M, Braun M. Post-COVID telogen effluvium. *Acta Dermatovenereol Croat*. 2022;30:220–6.
- Al-Dhalimi M, Al-Sabak H, Abbas NN. Clinical and trichoscopic features of post-COVID-19 telogen effluvium. *J Pak Assoc Dermatol*. 2024;34:392–9.
- Kuczara A, Waškiel-Burnat A, Rakowska A, Olszewska M, Rudnicka L. Trichoscopy of androgenetic alopecia: a systematic review. *J Clin Med*. 2024;13:1962.
- Fernández-Domper L, Ballesteros-Redondo M, Vañó-Galván S. Trichoscopy: an update. *Actas Dermosifiliogr*. 2023;114:327–33.
- Rakowska A. Trichoscopy in the healthy female: method standardization and norms for measurable parameters. *J Dermatol Case Rep*. 2009;3:14–9.
- Miteva M, Tosti A. Hair and scalp dermatoscopy. *J Am Acad Dermatol*. 2012;67:1040–8.
- Ross EK, Vincenzi C, Tosti A. Videodermoscopy in the evaluation of hair and scalp disorders. *J Am Acad Dermatol*. 2006;55:799–806.
- Gao M, Wang Y, Xu H, Xu C, Yang X, Nie J, et al. Deep learning-based trichoscopic image analysis and quantitative model for predicting basic and specific classification in male androgenetic alopecia. *Acta Derm Venereol*. 2022;102:adv00635.
- Di Fraia M, Tieghi L, Magri F, Caro G, Michelini S, Pellacani G, et al. A machine learning algorithm applied to trichoscopy for androgenic alopecia staging and severity assessment. *Dermatol Pract Concept*. 2023;13:e2023136.
- Chang WC, Chen KY, Cheng SY, Hsu CK, Yang CC. Mapping the hair density, thickness, and volume in normal and androgenetic alopecia subjects with the digital microscope. *J EADV Clin Pract*. 2023;2:174–8.
- Kasumagic-Halilovic E. Trichoscopic findings in androgenetic alopecia. *Med Arch*. 2021;75:109–11.
- Park HU, Chung KB, Kim DY. Quantitative measurement of hair diameter diversity as a diagnostic indicator of androgenetic alopecia in Korean males: a cross-sectional study. *JAAD Int*. 2024;15:121–6.
- Buontempo MG, Sperling LC, Alhanshali L, Shapiro J, Lo Sicco K. Establishing baselines of hair density measurements: variations across ethnicity, scalp region, and measurement techniques: a systematic review. *J Am Acad Dermatol*. 2023;89:1294–6.
- Rutnin S, Chanprapaph K, Pakornphadungsit K, Leerunyakul K, Visessiri Y, Srisont S, et al. Variation of hair follicle counts among different scalp areas: a quantitative histopathological study. *Skin Appendage Disord*. 2022;8:24–30.
- Katoulis AC, Kalloniati E, Chasapi V, Georgiou S, Rigopoulos D. A three-step diagnostic algorithm for alopecia: pattern analysis in trichoscopy. *J Clin Med*. 2025;14:1195.