# Utility of trichoscopy to diagnose early female pattern hair loss in resource-poor setting: A cross-sectional study

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## Abstract

**Background:** Trichoscopy is a reliable instrument for diagnosis and for tracking therapy-related changes in female pattern hair loss (FPHL). Videodermoscopic diagnosis of FPHL has been established, which requires fine measurements of hair-related parameters; the method requires an expensive equipment/digital program.

**Aim:** To determine whether a low-cost, simple USB dermoscope can ascertain the hair-related changes in early FPHL.

**Methods:** An age-matched, cross-sectional study was performed over 3 years on subjects with less than 6-month history of hair loss and without an obvious broadening of midline hair parting. Trichoscopic analysis of the frontal and occipital scalp of the study subjects were performed, using a USB-connected dermoscope. The subjects were analyzed for the presence of microscopic hair changes in the form of anisotrichosis, vellus-like hair, single hair follicle unit, peri-pilar sign and yellow dots.

**Results:** A total of 230 cases and 230 controls were analyzed. The dermoscopic hair changes were found to be significantly associated with the frontal scalp zone of cases.

**Limitations:** Histopathological evaluation of the cases was not done.

**Conclusion:** Microscopic changes recorded with the help of a simple USB dermoscope are helpful in establishing a diagnosis of FPHL even in early disease.

**Key words:** Dermoscope, early female pattern hair loss, trichoscopy

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## Introduction

Female pattern hair loss (FPHL) is a non-scarring progressive thinning of hair, with follicular miniaturization in a patterned distribution. Various clinical patterns of hair loss have been defined and used in the scales for assessing FPHL. Diffuse visible thinning of the crown region with preservation of frontal hairline have been described in Ludwig scale and Sinclair scale.[1,2] Similarly, thinning and widening of the central part of the scalp with the breach of frontal hairline have been described in Olsen Christmas tree pattern.[3] Also, thinning associated with the bitemporal recession is defined in Hamilton–Norwood scale.[4] Scales like Ludwig's require assessing the visible hair thinning on the crown, which is the reason why it fails to detect the early-stage FPHL.[5] The midline part and Christmas tree pattern are undoubtedly valuable clinical criteria in assessing FPHL, but they reflect

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the advanced stages of the condition. Thus, these scales are less useful for the diagnosis of an early stage of FPHL.[5]

Trichoscopy helps in better visualization of hair and scalp thereby aiding in the diagnosis of FPHL. The disease is characterized by the increased diversity of hair diameters, increased number of thin hairs (vellus-like hair), and an increased number of single hair containing follicular units, yellow dots, and peripilar sign.[6]

Recently, videodermoscopy criteria have also been published by Rakowska *et al*.[7] These are as follows: Major – (1) >4 yellow dots in four images in frontal area, (2) lower average hair thickness in the frontal area compared with occiput area, and (3) more than 10% of thin hairs (<0.03 mm) in the frontal area.

Minor – (1) ratio of single hair unit percentage, frontal to occiput > 2:1, (2) number of vellus hair, >1.5:1, and (3) ratio of perifollicular discoloration, >3:1.

The result of this study also indicates that FPHL may be differentiated from chronic telogen effluvium [Table 1].

The use of specialized instruments and dedicated software in this study allows for the precise measurement of hair-related structural changes. However, owing to high cost, these high-end videodermoscopes are not readily available to most of the dermatologists. Besides, this study does not demarcate the trichoscopic changes according to either the duration or severity of the disease.

Identifying the changes early in FPHL are more relevant, as an appropriate therapeutic intervention at this stage will halt the progression of FPHL.[5] If we could quantify the dermoscopic changes associated with early stages of FPHL, this could prove of great help, even greater if we could assess it using inexpensive dermoscopes. Trichoscopy may be performed with handheld dermoscopes, or with basic digital dermoscopes and photographic equipment, or with advanced digital dermoscopes.[6] Handheld dermoscopes may be divided into three groups: contact dermoscopes, polarized light contact dermoscopes, and polarized light noncontact dermoscopes.[6] Also available are handheld dermoscopes that work in either the contact or noncontact mode; these are known as hybrid dermoscopes. Which device to choose is a matter of individual preference; there is no preferred type of dermoscope for performing hair and scalp examinations. The standard magnification of handheld dermoscopes is ×10; the cost varies between about US $700 and US $1,800[6] (In India can get between 1000 rupees to 10,000 rupees). New devices on the market include simplified digital dermoscopes that may be connected to a computer (e.g., via USB) and kits allowing one to connect selected handheld dermoscopes to a regular photo camera. The usual magnification is ×10 to ×80, depending on the device.[6] The price of these devices varies between US $400 and US $2,000 (not including the computer, camera, or phone) The large, expensive digital dermoscopes (videodermoscopes) allow one to take high-magni fi cation, high-quality photographs.[6] The price of these devices varies signi fi cantly, depending on the presence or absence of software. This type of digital dermoscope offers multiple magni fi cations in the range of ×20 to ×70 (or ×100) and higher. The price varies from about US $10,000 to about US $20,000.[6] Low-cost versions, unlike high-end videodermoscopes, are unable to take exact measurements of FPHL-related variables. However, it may record a fairly good quality picture and it may be able to produce digital images capable of storage. Hence, we wished to assess whether a simple Universal Serial Bus (USB)-cable-connected dermoscope could be useful to aid in the diagnosis of early-stage FPHL. A dermoscope of this kind has to be connected to the computer through a USB port. Afterwards, the image through the dermoscope could be captured and recorded using image-capturing software. Some of the image-capturing software are available free of charge over World Wide Web (see below).

**Table 1: Trichoscopic features of telogen effluvium and androgenetic alopecia**

| Feature | Telogen effluvium | Androgenetic alopecia |
|---|---|---|
| Anisotrichosis[5] | Not present | Present |
| Vellus-like hair[5] | Not present | Present |
| Single hair containing follicular unit in the frontal area[6,7] | Present | Common |
| Upright regrowing hair[8] | Common | Not present |
| Empty hair follicles (including yellow dots)[8,9] | Present | Present |
| Peripillar sign[6,7] | Present | Common |
| Predominance of abnormalities in the frontal region[6,7] | Not present | Common |

Follicular miniaturization in the scalp is the hallmark of FPHL.[8] There is some role of androgens and genetic susceptibility described in this transformation. The higher level of 5α reductase and androgen receptors in frontal hair follicles probably explains patterned hair loss sparing the occiput. Increased aromatase enzyme activity in females also protects the scalp from undergoing total baldness.[8] Thus, logically we may assume that early changes in FPHL would be more pronounced in the frontal scalp, rather than any other part. Also, the occipital part would not be affected in patterned hair loss.

Therefore, we planned to evaluate and compare frontal and occipital scalps of study subjects. The evaluation was performed using an inexpensive USB dermoscope. We wanted to establish criteria associated with early FPHL using such a device. This would help in the diagnosis of future patients of early FPHL with the convenience of rapid, low-cost, and easy-to-use USB dermoscope.

## Methods

This was a cross-sectional study performed at the outpatient facility in the Department of Dermatology, Venereology and Leprosy of Mahatma Gandhi Memorial Medical College, Indore, India. During this study, trichoscopic images from the frontal and occipital scalp of females suffering from early patterned hair loss and healthy controls were analyzed. Females belonging to the age group of 18–35 years with the subjective complaint of hair loss of duration not more than 6 months were analyzed by USB dermoscope. We considered that 6 months history of hair loss would be sufficient to assume early FPHL. A longer duration of hair loss would produce a clinically diagnosable parting in midline scalp. We wanted to study early FPHL where clinically significant parting has not occurred. Thus, patients with the width of central parting not extending beyond 1 cm were included [Figure 1]. Inclusion criterion of hair parting span of less than 1 cm was arbitrarily chosen. There are several reasons for accepting this criterion. First, current literature lacks any precise definition of midline hair parting spread to differentiate early from late patterned hair loss. Second, we think parting spread of more than 1 cm could be sufficient enough to make a clinical diagnosis of patterned hair loss obviating the need for a dermoscopy. Third, the objective of our study is to assess the utility of trichoscopy in evaluating early FPHL, where the patient has still not lost enough hair density for an obvious clinical diagnosis. Furthermore, analysis of central parting is important in FPHL as suggested by Hung *et al*.[9]

**Figure 1:** Measurement of midline parting spread using a Schirmir's tear test strip; this case had different dermoscopic findings in her frontal scalp compared with the occipital scalp

Because pattern hair loss predominantly affects frontal scalp, subjects with the relative dermoscopic difference in hair-related variables in frontal and occipital areas were only recruited as cases. Patients with hair loss with similar occipital and frontal dermoscopic findings may be suffering from telogen effluvium instead of FPHL,[7,10] and thus were excluded from the study.

Patients with hair loss following an acute illness or following pregnancy were excluded. Females with other obvious hair and scalp disorders either primary like trichotillomania, alopecia areata, or tinea capitis or secondary like seborrheic dermatitis or psoriasis were also excluded. Patients who were on any type of anti-hair loss treatment or patients with endocrine disorders or patients on systemic allopathic or alternative medications were excluded.

Age-matched controls without history of hair loss were recruited from hospital patients and attendants. The controls were recruited during the same period of time as the cases. For each case, the control was recruited using the same exclusion criteria.

All the subjects were asked to shampoo their hair 1 day prior to the procedure. They were asked to avoid oiling or coloring their hair. A straight parting was obtained at the mid-scalp with a fine-toothed comb. Trichoscopy was performed using a USB-cable-connected dermoscope manufactured by Tejco Vision® (Mumbai, India), which provides scalp visualization at 5 × to 200×. Snap® software was used to analyze and record the dermoscopic images. Snap® software is a free web-app available for download from the World Wide Web.

It has been suggested that in patterned hair loss, trichoscopic examination should be performed in the frontoparietal area approximately at the cross between the nose line and ear implantation.[11] Also, Rakowska

**Table 2: Details of modified dermoscopic criteria for recording of structural hair changes**

| Definition | Method of evaluation | Remarks |
|---|---|---|
| Anisotrichosis[12] | Presence of hairs of smaller shaft width when compared with the surrounding hairs in the same field of vision | As we are using two-dimensional picture, we are defining the width in place of the diameter of the hair shaft |
| Vellus-like hair[13] | Such small, fine hairs whose both ends are visible in the same recorded image | In the study, where videodermoscope was used, the vellus hair were identified as thin short hair interspaced among normal and thinner hair. The criteria to count vellus hair included visualization of hair emergence and measuring the hair that were <0.03 mm in diameter and <2 mm length ×70 magnification. |
| Single HFU[7] | Presence of single hair containing follicular units | |
| Yellow dots[14] | Presence of empty follicles with yellowish discoloration | |
| Peripilar sign[15] | Presence of perifollicular brownish halo | |

HFU: hair follicular unit

*et al*. have suggested that the trichoscopic evaluation of temporal area may be ignored in dermatology practice.[7] Furthermore, pattern hair loss–induced dermoscopy changes observed in the frontal area are more pronounced compared to the occipital area. Considering the above facts, the frontal and occipital scalp were examined in the midline (sagittal plane) approximately 3 cm above the hairline at 50× magnification that covers the area of 5 × 7 $mm^2$. All the images evaluated for the hair changes are presented in Table 2.

Frontal scalp and occipital scalp of cases were compared with that of controls. Similarly, frontal scalp of cases was compared with the occipital area of their own.

Appropriate statistical analysis was performed using IBM SPSS Statistics 20. *P* value was calculated using McNemar's test. Evaluation of diagnostic accuracy of trichoscopic variables was performed using "Medcalc® diagnostic test evaluation calculator" available from the Internet as free statistical calculator.

The prevalence of FPHL in India is unknown. However, community-based surveys from China and Korea had shown a prevalence of 6% and 5.6%, respectively.[16] Thus, a population prevalence of 6% was considered for the sake of sample size calculation. Sample size calculation was performed according to a method described by Daly and Bourke.[17] The proportion of controls having the disease thus is expected to be 6% and we wished the study sample to be large enough to have a 90% chance of detecting a difference of 10% in cases, using a 5% two-sided level of significance. The sample size using the above method and considerations came out to be 201 subjects in each group.

To avoid interobserver bias, all the images were analyzed by the same investigator.

**Table 3: Baseline characteristics of the study population**

| Characteristics | Cases | Controls |
|---|---|---|
| Age range (years) | 18-35 | 18-35 |
| Mean (years) | 24.15 | 25.80 |
| Total number | 230 | 230 |

## Results

A total of 4368 females with the complaint of hair loss presented during the study period. A total of 230 subjects in each group were recruited. Images from subjects having the presence of scaling or colored scalp skin or blurred images were rejected. Finally, the data obtained from 230 cases and controls were analyzed. Baseline characteristics of study subjects are given in Table 3.

Trichoscopic findings over the frontal area and the occipital area of cases and control group are described in Table 4.

**Table 4: Frequency of trichoscopic findings over selected portions of scalps of cases and controls**

| Trichoscopic variables | Case | Control | *P* |
|---|---|---|---|
| Frontal area | | | |
| Anisotrichosis | 230 | 34 | <0.001* |
| Vellus-like hair | 213 | 28 | <0.001* |
| Single hair follicular unit | 176 | 64 | <0.001* |
| Yellow dots | 17 | 0 | <0.001* |
| Peripilar sign | 43 | 4 | <0.001* |
| Occipital area | | | |
| Anisotrichosis | 15 | 10 | 0.219 |
| Vellus hair | 38 | 27 | 0.070 |
| Single hair follicular unit | 74 | 63 | 0.094 |
| Yellow dots | 0 | 0 | - |
| Peripilar sign | 3 | 2 | 0.675 |

*n*=460, *P* value calculated using McNemar's test; significant results have been marked with a superscript asterisk

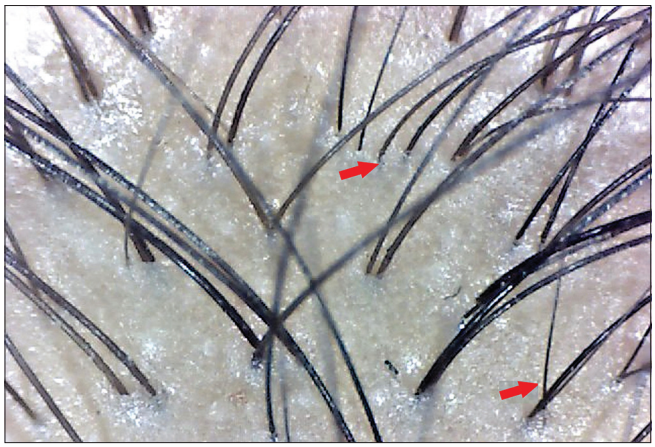

**Figure 2a:** ×50; nonpolarized, anisotrichosis marked as red arrows over frontal scalp

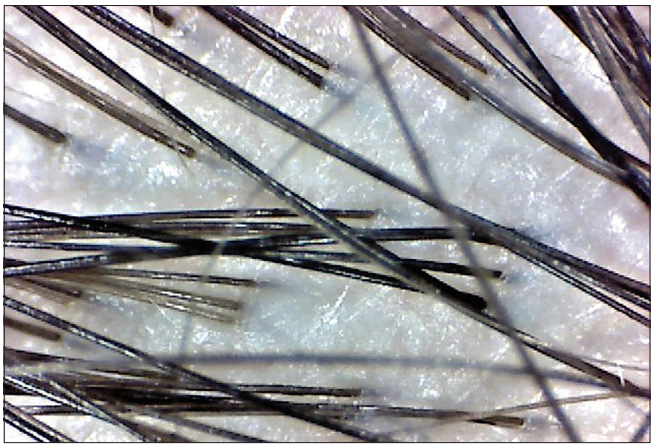

**Figure 2b:** ×50; nonpolarized, occipital scalp of same subject for comparision

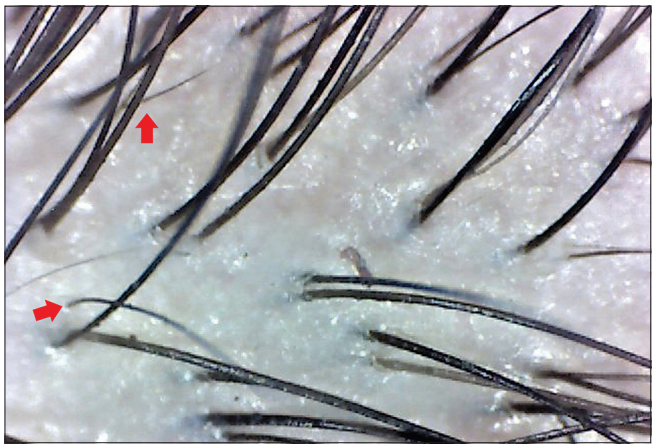

**Figure 3a:** ×50; nonpolarized, vellus-like hair over the frontal scalp marked by red arrow (refer to Table 2 for definition of vellus-like hair)

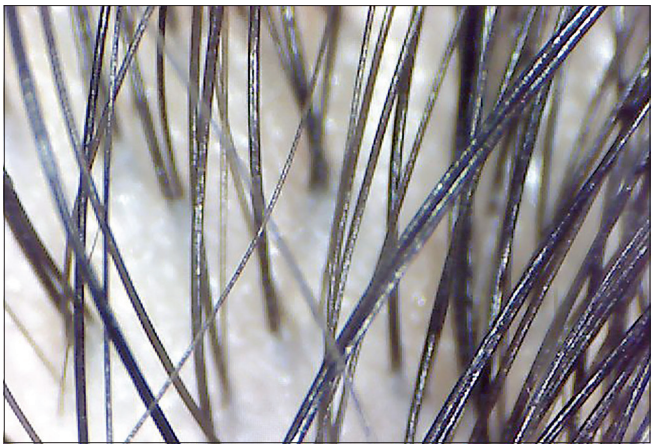

**Figure 3b:** ×50; nonpolarized, occipital scalp of same subject for comparision

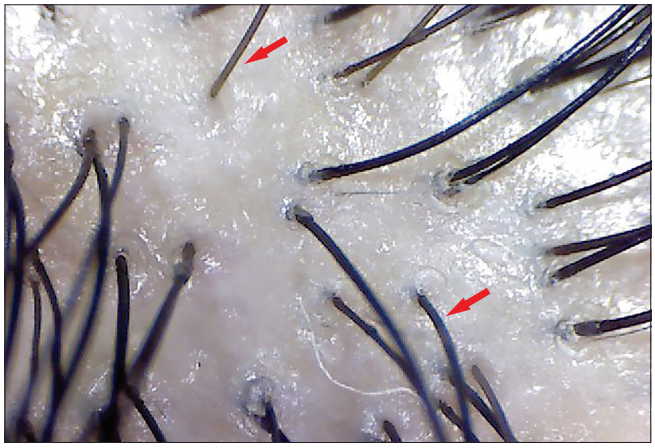

**Figure 4a:** ×50; nonpolarized, single hair follicle unit marked as red arrows over the frontal scalp

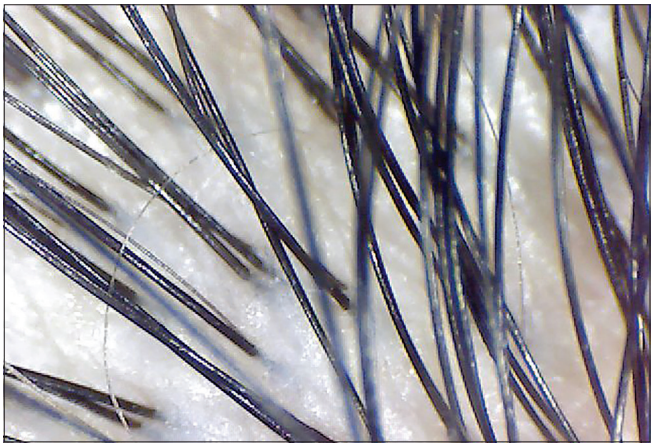

**Figure 4b:** ×50; nonpolarized, occipital Scalp of same subject for comparision

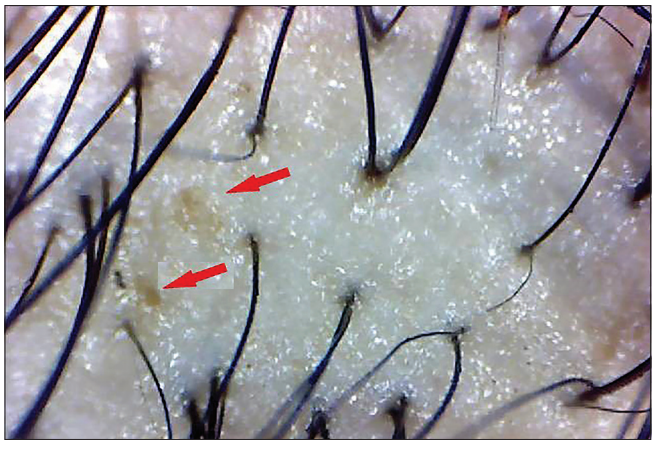

**Figure 5a:** ×50; nonpolarized, yellow dots are marked with red arrows

**Figure 5b:** ×50; nonpolarized, peripilar sign is marked with red arrow

All the cases in the frontal area showed anisotrichosis [Figure 2a] and an increase in the number of vellus-like hairs [Figure 3a, when compared to their own occipital scalp [Figure 2b, 3b]]. Hair follicle unit containing a single hair [Figure 4a] was also observed in a significant number of cases in the frontal area (as above, when compared to their own occipital scalp [Figure 4b]).

However, yellow dots and peripilar sign [Figure 5] were noticeable in fewer study subjects. This is because non polarized dermoscopy was done, where these findings are not well seen. Hence, this finding does not have significance in this study.

Similar findings were also observed in the frontal area of controls but less pronounced.

Dermoscopic changes defined by the presence of anisotrichosis, vellus hair, single hair follicular unit, peripilar sign and yellow dots were found to be significantly associated with the frontal scalp of cases when compared with the frontal scalp of controls. Also, the frontal scalp of cases differed significantly from their own occipital areas. However, changes between occipital areas of cases and controls were not significantly different. Furthermore, the occipital area of the controls did not differ significantly from their frontal area. Thus, we may deduce that dermatoscopic findings mentioned above are significantly associated with the frontal scalp of cases only.

## Discussion

In our study, we have recognized the changes in early FPHL using a low-cost, easy, and rapidly usable USB dermoscope. We have defined early FPHL on the basis of duration of the subjective complaint and the width midline hair parting, which were 6 months and 1 cm, respectively.

In a recent study, Rakowska *et al*. have established the trichoscopic criteria to diagnose FPHL.[7] However, diagnoses using these parameters require measurements performed through videodermoscope. Such instruments are costly and may not be available to most of the dermatologists, especially in resource-poor setting. As these criteria have already been established, we wanted to use them for the purpose of our study and at the same time, we wanted to assess these parameters using a simple dermoscope. Thus, we modified the parameters laid down by Rakowska *et al*. and recorded them using a simple dermoscope in the manner described in Table 2.[7]

Variation in hair shaft diameter is the most common feature observed in FPHL. This finding is also termed as anisotrichosis.[12] It classically reflects hair miniaturization due to disease (this feature correlates well with histopathological picture). Previous studies have described anisotrichosis of >20% hair follicles as significant of FPHL.[7,13,18] This finding was present in the frontal scalp of all the cases in our study. Also, there is an increased proportion of thin hair observed in the frontal area relating to hair miniaturization. Bhamla *et al*.[10] in their study had compared trichoscopic changes in females with early hair loss (<6 months) with groups of healthy controls and with late stages of the disease. However, they used a single trichoscopic parameter of hair diameter diversity (anisotrichosis), and histopathological correlation was also done. In this study, the case group comprised patients of FPHL and chronic telogen effluvium, and two patients of indeterminate histopathological diagnosis. They used only a single parameter of hair diameter diversity and suggested that trichoscopy could diagnose 75% of grade I FPHL when this parameter is present in more than 20% of hair. In our study, while comparing the frontal scalp with occipital scalp of controls, we have found that anisotrichosis achieved statistical significance [Table 5] suggesting healthy females may also have significantly increased hair diameter variability in the frontal scalp. Thus, until an exact percentage of anisotrichosis has been calculated or until a suitable reference (like occipital area) is assessed, this parameter alone may not be a good tool for screening.

The normal hair follicular unit comprises one to four terminal hair with one to two vellus hair. However, the frontal scalp of cases showed an increased number of hair follicles containing single hair. Thus, increased thinning of hair and increase in the number of single hair follicular units with predominant prevalence in the frontal area are the main features observed in FPHL.

Previous studies have also described peripilar sign and yellow dots as the features of androgenic alopecia.[7] An approximately 1 mm brownish hyperpigmented halo around the follicular ostium reflects the presence of perifollicular lymphocytic infiltration, typical of the early stage of the disease.[15] However, in our study, it was found in only 43 (18.7%) cases in the frontal scalp. Similarly, another study done on Asian population showed that perifollicular pigmentation was less appreciated on the Asian scalp compared with the white population.[19] Yellow dots are the most common feature of alopecia areata, but it may be present in a wide spectrum of hair diseases, and thus it is not very specific for FPHL.[20] These dots represent empty follicular ostium and persistent sebaceous gland even after severe miniaturization of the follicles.[15] We found yellow dots in 17 (7.4%) cases suggesting this change is rare in the early stage of the disease. However, our findings should be interpreted with caution here since we used non-polarized dermoscopy in our study.

In our study, we found that hair-related trichoscopy changes, when assessed together, were significantly associated only

**Table 5: Comparison of trichoscopic findings over frontal and occipital scalp of cases and controls**

| Trichoscopic variables | Frontal area | Occipital area | *P* |
|---|---|---|---|
| Cases | | | |
| Anisotrichosis | 230 | 15 | <0.01* |
| Vellus-like hair | 213 | 38 | <0.01* |
| Single hair follicular unit | 176 | 74 | <0.01* |
| Yellow dots | 17 | 0 | <0.01* |
| Peripilar sign | 43 | 3 | <0.01* |
| Controls | | | |
| Anisotrichosis | 34 | 10 | <0.01* |
| Vellus-like hair | 28 | 27 | 1.0 |
| Single hair follicular unit | 64 | 63 | 1.0 |
| Yellow dots | 0 | 0 | - |
| Peripilar sign | 4 | 2 | 0.28 |

*P*-value calculated using McNemar's test; significant results have been marked with a superscript asterisk

**Table 6: Evaluation of diagnostic accuracy of different trichoscopic variables**

| Variables | Percentage (95% CI) | | | | |
|---|---|---|---|---|---|
| | Sensitivity | Specificity | Positive likelihood ratio | Positive predictive value | Negative predictive value |
| Frontal scalp of cases versus frontal scalp of controls | | | | | |
| Anisotrichosis | 100 (98.4-100) | 85.2 (80.1-89.5) | 6.8 (4.9-9.2) | 87.1 (83.2-90.2) | 100 (98.4-100) |
| Vellus-like hair | 92.6 (88.4-95.6) | 87.8 (82.9-91.8) | 7.6 (5.4-10.8) | 88.4 (84.2-91.5) | 92.2 (88.2-94.9) |
| Single hair follicle unit | 76.5 (70.5-81.8) | 72.2 (65.9-77.9) | 2.7 (2.2-3.4) | 73.3 (68.8-77.4) | 75.5 (70.6-79.7) |
| Yellow dots | 7.4 (4.4-11.6) | 100 (98.4-100) | 10.7 (10.6-10.8) | 100 | 51.9 (51.0-52.9) |
| Peripilar sign | 18.7 (13.9-24.3) | 98.3 (95.6-99.5) | 10.7 (3.9-29.5) | 91.5 (79.7-96.7) | 54.7 (53.1-56.3) |
| Frontal scalp of cases versus occipital scalp of cases | | | | | |
| Anisotrichosis | 100 (98.4-100) | 93.5 (89.5-96.3) | 15.33 (9.4-25.0) | 93.9 (90.1-96.2) | 100 |
| Vellus-like hair | 92.6 (88.4-95.6) | 83.5 (78.0-88.0) | 5.6 (4.2-7.5) | 84.9 (80.7-88.2) | 91.9 (87.6-94.7) |
| Single hair follicle unit | 76.5 (70.5-81.8) | 67.8 (61.4-73.8) | 2.4 (1.9-2.9) | 70.4 (66.1-74.4) | 74.3 (69.2-78.8) |
| Yellow dots | 7.4 (4.4-11.6) | 100 (98.4-100) | - | 100 | 51.9 (51.0-52.9) |
| Peripilar sign | 18.7 (13.9-24.3) | 98.7 (96.2-99.7) | 14.3 (4.5-45.5) | 93.5 (81.8-97.8) | 54.8 (53.2-56.4) |

CIs: confidence intervals. CIs for sensitivity and specificity are "exact" Clopper–Pearson CI. CIs for the likelihood ratio are calculated using "log method." CIs for the predictive values are the standard logit CIs

with the frontal scalp of the patient suffering from early FPHL [Table 6]. Similarly, the occipital area of the patients suffering from FPHL was not different from healthy subjects. Thus, in an individual having FPHL, their own occipital area can be used to compare frontal area, for assessing dermoscopically [Table 6].

### Limitations

We consider that our study is limited by the absence of histopathological evaluation of our cases. However, several previous studies have already confirmed the relationship between histopathological and dermoscopic parameters of FPHL. Also, recruiting patients of telogen effluvium as one of the control groups would have been desirable. However, it is difficult to diagnose and differentiate telogen effluvium by trichoscopy.[11]

Telogen effluvium has no specific trichoscopic criteria, even less so in early stages of the disease; thus we have excluded such cases on clinical grounds.[11]

To summarize, our study has found that even in early stages of FPHL, frontal scalp can be differentiated from the occipital scalp using a simple dermoscope.

Also, the hair changes, which we have studied, were able to differentiate the frontal scalp finding of early FPHL from normal control. Our study finding suggests that the occipital area in cases and controls have similar dermoscopic picture. So, in cases of early FPHL, the occipital area may serve as a reliable comparison zone for analysis of frontal scalp by dermoscopy.

## Conclusion

From the above study, it can be concluded that a dermoscope is an excellent tool for the preliminary evaluation of females with history of hair loss as recent as 6 months. Moreover, diagnosis of early FPHL can be suggested using a dermoscope incapable of taking precise hair related measurements. Dermoscopic changes in the form of anisotrichosis, vellus-like hair, single hair follicular unit, peripilar sign and yellow dots, when taken together, may be used for diagnosis of early FPHL, provided the frontal scalp of the subject has these changes and the occipital scalp does not.

### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

### Conflicts of interest

There are no conflicts of interest.

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