Dermatol Ther (Heidelb) (2026) 16:1757–1765
https://doi.org/10.1007/s13555-026-01672-7

ORIGINAL RESEARCH

Dermoscopy of Prurigo Nodularis/Lichen Simplex Chronicus of the Scalp: A Comparative Observational Study in Fair and Dark Skin

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Received: November 4, 2025 / Accepted: January 26, 2026 / Published online: February 22, 2026

ABSTRACT

***Introduction*:** Although recognition of prurigo nodularis (PN) and lichen simplex chronicus (LSC) of the scalp is usually straightforward, they may sometimes pose difficulties in terms of differential diagnosis with other similar dermatoses. The aim of this observational retrospective study was to assess dermoscopic features of PN and LSC of the scalp across fair- and dark-skinned individuals and compare them with those of clinical mimickers.

***Methods*:** Fair-skinned (Fitzpatrick phototypes I–III) and dark-skinned (Fitzpatrick phototypes IV–VI) patients with a histological diagnosis of PN/LSC of the scalp, along with controls, were considered. All the images were randomly evaluated by two independent investigators to identify findings according to standardized criteria. Interobserver agreement was evaluated through Cohen's kappa coefficient, while Fisher's exact test with p value set at 0.01 was used for comparative analyses between cases and controls.

***Results*:** The study included 79 cases, including 40 instances of PN/LSC of the scalp (27 with fair skin and 13 with dark skin) and 39 controls. The most common dermoscopic findings (>1/3 of cases) of PN/LSC in both light and dark phototypes included sparse follicular plugs, broken hairs, purple structureless areas, broom-like hairs, and erosions. Additionally, purple dots, perivascular white halo and dotted vessels with unspecific distribution were also common in fair skin, while white lines (peripheral-radial) and structureless areas turned out to be as frequent in dark skin. Comparative analysis showed that dotted vessels,

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follicular plugs, broken hairs, broom-like hairs, purple structureless areas, and perivascular white halo were more common compared to control in light phototypes, whereas only erosions, peripheral white lines, and purple structureless areas reached statistical significance in dark-skinned patients ($p<0.01$). Kappa values were 0.88 and 0.81 for fair and dark skin, respectively.

Conclusion: Dermoscopy is a valuable adjunct in the non-invasive diagnosis of PN and LSC of the scalp, with good reproducibility across skin phototypes.

Keywords: Diagnosis; Differential diagnosis; Prurigo nodularis; Lichen simplex chronicus; Scalp dermatoses

Key Summary Points

Why carry out this study?

Even though diagnosis of prurigo nodularis and lichen simplex chronicus of the scalp is usually easy, they may be sometimes mistaken for other similar dermatoses.

Dermoscopy has been showed to be helpful in supporting the recognition of inflammatory conditions, thus reducing the possible number of invasive diagnostic procedures (i.e., biopsy).

What was learned from the study?

The most common dermoscopic findings of prurigo nodularis and lichen simplex chronicus in both light and dark phototypes included sparse follicular plugs, broken hairs, purple structureless areas, broom-like hairs, and erosions.

Comparative analysis showed that dotted vessels, follicular plugs, broken hairs, broom-like hairs, purple structureless areas, and perivascular white halo were more common compared to control in light phototypes, whereas only erosions, peripheral white lines, and purple structureless areas reached statistical significance in dark-skinned patients.

INTRODUCTION

Prurigo nodularis (PN) and lichen simplex chronicus (LSC) are chronic pruritic skin diseases resulting from self-perpetuating repetitive scratching that leads to skin thickening and inflammation [1]. Although PN classically presents with firm nodules featuring hyperkeratotic or excoriated surface and LSC as thickened, lichenified, and hyperkeratotic plaques, they frequently exhibit a clinical overlap on the scalp [1]. Although commonly reported on the extremities and trunk, their presence on the scalp is often underrecognized and misdiagnosed, with consequent management mistakes. In this regard, dermoscopy has been showed to be a helpful tool to facilitate the recognition of inflammatory dermatoses, including PN and LSC, yet data on scalp involvement is limited. Additionally, such conditions are particularly common in skin of color, and knowledge on dermoscopy coming from populations with fair skin is often not applicable in darker phototypes. In this study, we aimed to assess dermoscopic features of PN/LSC of the scalp in patients with fair and dark skin phototypes, comparing them with their main differential diagnoses.

METHODS

This was a multicentric, retrospective observational study conducted across three dermatological centers in Italy (Udine, Bologna) and Nigeria (Nnewi). Consecutive patients were included in the analysis and divided into two main cohorts, fair-skinned (Fitzpatrick phototypes I–III) and dark-skinned (Fitzpatrick phototypes IV–VI) individuals, each comprising subjects diagnosed with either PN or LSC of the scalp by histology. For both groups, controls were also analyzed, including patients affected by any other scalp itchy lesions/disorders in which PN or LSC were included in the clinical differential diagnosis. Only instances with high-quality dermoscopic images of the target area (i.e., bioptic sample site or the most clinically representative lesion) were considered, while patients who had received systemic or topical specific therapies in the previous 8 weeks were excluded from the study. Notably,

we focused on the scalp rather than performing full-body dermoscopy because dermoscopic features of PN/LSC are less ambiguous on other body sites, whereas on the scalp they can be more easily confused with other inflammatory scalp disorders. Furthermore, our study focused exclusively on inflammatory mimickers. Malignant lesions were intentionally not included in the differential diagnosis because these patients present with multiple lesions, and neoplastic lesions are less likely to present as multiple lesions.

All cases were examined using a ×10 magnification handheld dermatoscope (e.g., DermLite DL5, San Juan Capistrano, CA, USA) equipped with a high-resolution digital camera or a smartphone device attached to the dermatoscope; polarized setting was used in all instances, with the possible additional use of a fluid interface based on the physician's evaluation. Images were randomly evaluated by two independent experienced investigators (study coordinators: E.E. and N.P.) blinded to the final diagnosis, who assessed dermoscopic findings according to the International Dermoscopy Society criteria for non-neoplastic dermatoses [2] integrated with parameters proposed by Rudnicka et al. for follicular findings [3]. Prevalence of dermoscopic features in both LSC/PN and control groups was calculated, and comparative analysis was also performed separately for fair- and dark-skinned patients. Statistical analysis was carried out using Microsoft Excel, ensuring systematic data handling and accurate computation of values. Interobserver agreement was evaluated through Cohen's kappa coefficient, while Fisher's exact test with p value set at 0.01 was used for comparative analyses.

The patients in this manuscript provided informed consent for the publication of case details and images, and institutional approval was not required, as the study was based on data retrospectively collected in a routine clinical setting, consistently with AIFA (Italian Medicines Agency) regulation (AIFA Determination, March 20, 2008). This study complies with the Declaration of Helsinki and no ethical approval was required as it results from routine clinical activity. Accessed data for the study complied with relevant data protection and privacy regulations.

RESULTS

A total of 79 patients were included in the study: 40 with PN/LSC of the scalp [27 of them with Fitzpatrick phototypes I–III (fair skin) and 13 with phototypes IV–VI (dark skin)], and 39 controls [24 fair-skinned and 15 dark-skinned subjects, including psoriasis, discoid lupus erythematosus, tinea capitis, and lichen planopilaris (both fair and dark skin), acne keloidalis and folliculitis decalvans (only for the dark skin)]. Further details are shown in Tables 1 and 2.

Considering fair-skinned patients (Fig. 1 and Table 1), the most prevalent dermoscopic findings (>one-third of cases) in the PN/LSC group were follicular plugs (sparse) (88.9%), broken hairs (81.5%), purple structureless areas (66.7%), perivascular white halo (66.7%), broom-like hairs (59.3%), dotted vessels with unspecific distribution (55.6%), erosions (51.9%), and purple dots (44.4%). In the comparative analyses, the following findings were statistically more common in PN/LSC compared to controls (Table 1): sparse follicular plugs ($p<0.001$), broken hairs ($p<0.001$), broom-like hairs ($p<0.001$), perivascular white halo ($p<0.001$), purple (hemorrhagic) structureless areas (focal) ($p<0.001$), and dotted vessels (unspecific distribution) ($p<0.003$). Of note, follicular plugs and broken hairs were seen only in 8.3% and 12.5% of controls, while broom-like hairs and perivascular white halo were absent in the control cohort.

Among patients with dark skin tones (Fig. 2 and Table 2), broken hairs (61.5%), follicular plugs (sparse) (53.8%), purple structureless areas (focal) (46.2%), white lines (peripheral-radial distribution) (46.2%), erosions (46.2%), and white structureless areas (focal) (38.5%) turned out to be the most common dermoscopic findings (>one-third of cases) of PN/LSC. Of note, erosions, peripheral white lines, and purple structureless areas reached statistical significance ($p<0.01$) compared to controls, while sparse follicular plugs showed only a tendency towards the significancy ($p=0.011$). Kappa values were 0.88 and 0.81 ("almost perfect" agreement) for fair and dark skin, respectively.

Table 1 Dermoscopic findings of included instances of lichen simplex chronicus/prurigo nodularis (LSC/PN) of the scalp and controls in fair-skinned patients (phototypes I–III), along with results of the comparative analysis

Dermoscopic finding[a]	LSC/PN ($n = 27$) (prevalence)	Controls ($n = 24$)[b] (prevalence)	p value***
Vessels			
Linear-curved vessels (unspecific distribution)	3 (11.1%)	6 (25.0%)	0.276
Dotted vessels (unspecific distribution)	15 (55.6%)	3 (12.5%)	0.003
Dotted vessels (uniform distribution)	9 (33.3%)	8 (33.3%)	1.000
Linear vessels (unspecific distribution)	2 (7.4%)	4 (16.7%)	0.402
Linear vessels with branches (unspecific distribution)	3 (11.1%)	4 (16.7%)	0.693
Scales/crusts			
White scales (focal)	18 (66.7%)	21 (87.5%)	0.105
White scales (perifollicular)	4 (14.8%)	13 (54.2%)	0.007
Yellow scales/crusts (focal)	3 (11.1%)	2 (8.3%)	1.000
Yellow scales/crusts (perifollicular)	2 (7.4%)	0 (0.0%)	0.492
Follicular findings			
Follicular plugs (sparse)	24 (88.9%)	2 (8.3%)	< 0.001
Follicular plugs (regular/uniform)	0 (0.0%)	4 (16.7%)	0.043
Black dots	7 (25.9%)	6 (25.0%)	1.000
Broken hairs	22 (81.5%)	3 (12.5%)	< 0.001
Broom-like hairs	16 (59.3%)	0 (0.0%)	< 0.001
Comma-like/corkscrew-like hairs	0 (0.0%)	4 (16.7%)	0.043
Bent/zig-zag hairs	0 (0.0%)	2 (8.3%)	0.217
Morse-code hairs	0 (0.0%)	2 (8.3%)	0.217
Other structures			
White structureless areas (focal)	8 (29.6%)	6 (25.0%)	0.762
Purple (hemorrhagic) structureless areas (focal)	18 (66.7%)	3 (12.5%)	< 0.001
White lines	4 (14.8%)	8 (33.3%)	0.187
Purple (hemorrhagic) dots	12 (44.4%)	4 (16.7%)	0.040
Clues			
Perivascular white halo	18 (66.7%)	0 (0.0%)	< 0.001
Erosions	14 (51.9%)	4 (25.0%)	0.018

[a]Analysis performed according to the International Dermoscopy Society criteria for non-neoplastic dermatoses [2] integrated with parameters proposed by Rudnicka et al. [3] for follicular findings

[b]Eight psoriasis, seven discoid lupus erythematosus, five tinea capitis, and four lichen planopilaris

***$p < 0.01$ deemed as statistically significant

Table 2 Dermoscopic findings of included instances of lichen simplex chronicus/prurigo nodularis (LSC/PN) of the scalp and controls in dark-skinned patients (phototypes IV–VI), along with results of the comparative analysis

Dermoscopic finding[a]	LSC/PN ($n = 13$) (prevalence)	Controls ($n = 15$)[b] (prevalence)	p value***
Vessels			
Linear-curved vessels (unspecific distribution)	0 (0.0%)	2 (13.3%)	0.484
Dotted vessels (unspecific distribution)	4 (30.8%)	0 (0.0%)	0.035
Dotted vessels (uniform distribution)	3 (23.1%)	0 (0.0%)	0.087
Linear vessels (unspecific distribution)	0 (0.0%)	0 (0.0%)	1.000
Linear vessels with branches (unspecific distribution)	0 (0.0%)	0 (0.0%)	1.000
Scales/crusts			
White scales (focal)	4 (30.8%)	11 (73.3%)	0.029
White scales (perifollicular)	2 (15.4%)	9 (60.0%)	0.056
Yellow scales/crusts (focal)	2 (15.4%)	4 (26.7%)	0.655
Yellow scales/crusts (perifollicular)	2 (15.4%)	4 (26.7%)	0.655
Follicular findings			
Follicular plugs (sparse)	7 (53.8%)	1 (6.7%)	0.011
Follicular plugs (regular/uniform)	1 (7.7%)	5 (33.3%)	0.173
Black dots	2 (15.4%)	4 (26.7%)	0.655
Broken hairs	8 (61.5%)	2 (13.3%)	0.016
Broom-like hairs	3 (23.1%)	0 (0.0%)	0.087
Comma-like/corkscrew-like hairs	0 (0.0%)	3 (20.0%)	0.226
Other structures			
White structureless areas (focal)	5 (38.5%)	7 (46.7%)	0.718
Purple (hemorrhagic) structureless areas (focal)	6 (46.2%)	0 (0.0%)	0.005
White lines (unspecific distribution)	2 (15.4%)	4 (26.7%)	0.655
White lines (peripheral-radial distribution)	6 (46.2%)	0 (0.0%)	0.005
Purple (hemorrhagic) dots	3 (23.1%)	0 (0.0%)	0.087
Clues			
Perivascular white halo	4 (30.8%)	0 (0.0%)	0.035
Erosions	6 (46.2%)	0 (0.0%)	0.005
Cobblestone white pattern[c]	2 (15.4%)	0 (0.0%)	0.206

[a]Analysis performed according to the International Dermoscopy Society criteria for non-neoplastic dermatoses [2] integrated with parameters proposed by Rudnicka et al. [3] for follicular findings

[b]Four discoid lupus erythematosus, three tinea capitis, three acne keloidalis, three folliculitis decalvans, two lichen planopilaris

[c]Multiglobular white structures

Table 2 continued

***$p < 0.01$ deemed as statistically significant

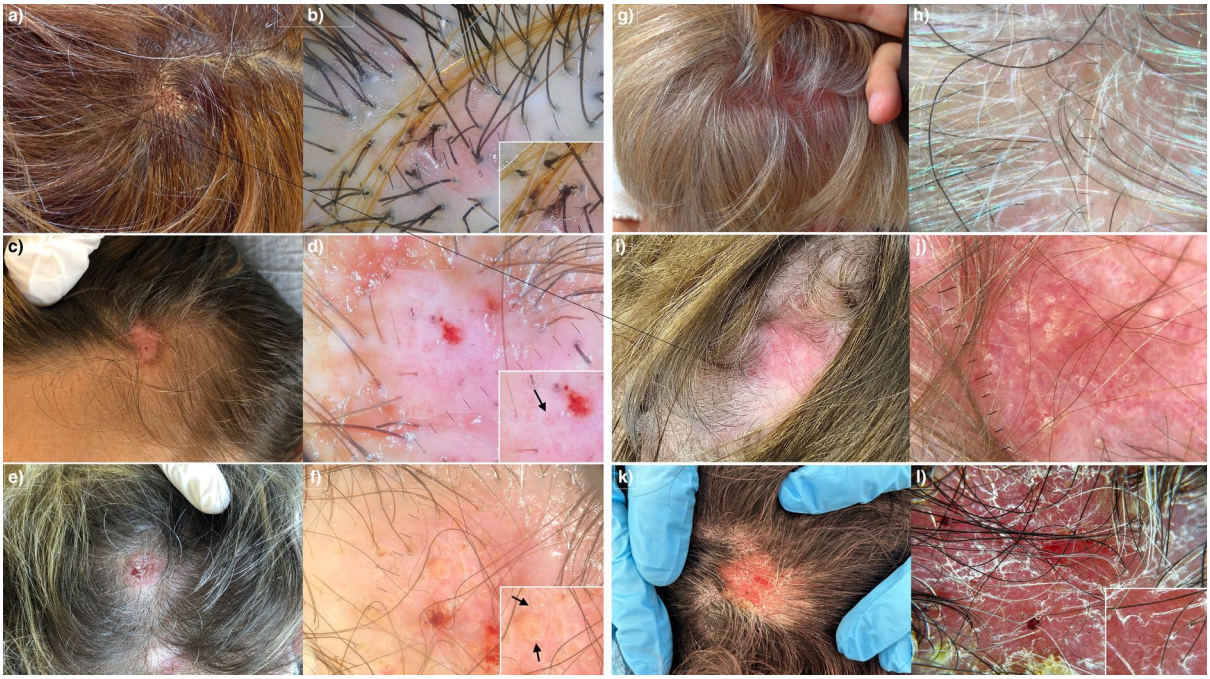

Fig. 1 Instances of lichen simplex chronicus/prurigo nodularis (**a**–**f**) compared to controls (**g**–**l**) in fair-skinned patients (phototypes I–III). Clinical image showing a lichenified patch on the scalp (**a**); dermoscopy reveals broom-like hairs (better visible in the box) and broken hairs (**b**). Clinical examination displays a patch of alopecia of the frontotemporal area (**c**); dermoscopic features include broken hairs, perivascular white halos, dotted vessels, sparse follicular plugs (black arrow), and focal hemorrhagic structureless areas (**d**). An erythematous patch of hair loss along with white scales and erosions on clinical examination (**e**); dermoscopic evaluation shows follicular plugs, hemorrhagic structureless areas, and uniformed dotted vessels (black arrows) (**f**). Lichen planopilaris: clinical image (**g**); dermoscopy displays perifollicular white scales and bright white areas (**h**). Clinical picture of discoid lupus erythematosus (**i**); dermoscopic assessment reveals follicular plugs along with linear-curved vessels (**j**). Psoriasis: clinical image (**k**); dermoscopy examination shows regularly arranged dotted vessels and white scales on a light-to-dull red background

DISCUSSION

According to our study, dermoscopy may be useful in facilitating the recognition of PN/LSC of the scalp, regardless the skin type. Specifically, in our analysis, broken hairs and purple hemorrhagic structures emerged as possible diagnostic clues in both fair and dark skin as they were less common in clinically similar dermatoses. Notably, both these findings likely reflect repeated mechanical trauma due to chronic scratching [4, 5]. Additionally, broom-like hairs (short hairs with a single root distally splitting into 2–3 shafts) [6, 7], sparse follicular plugs, unspecifically distributed dotted vessels, and perivascular white halos were also found to be possible diagnostic markers of PN/LSC in fair-skinned individuals, whereas erosions, peripheral white radiating lines, and white structureless areas turned out to be possible indicators or PN/LSC in skin of color. Accordingly, peripheral white radiating lines (the so-called white starburst pattern) were also described by Errichetti et al. as a

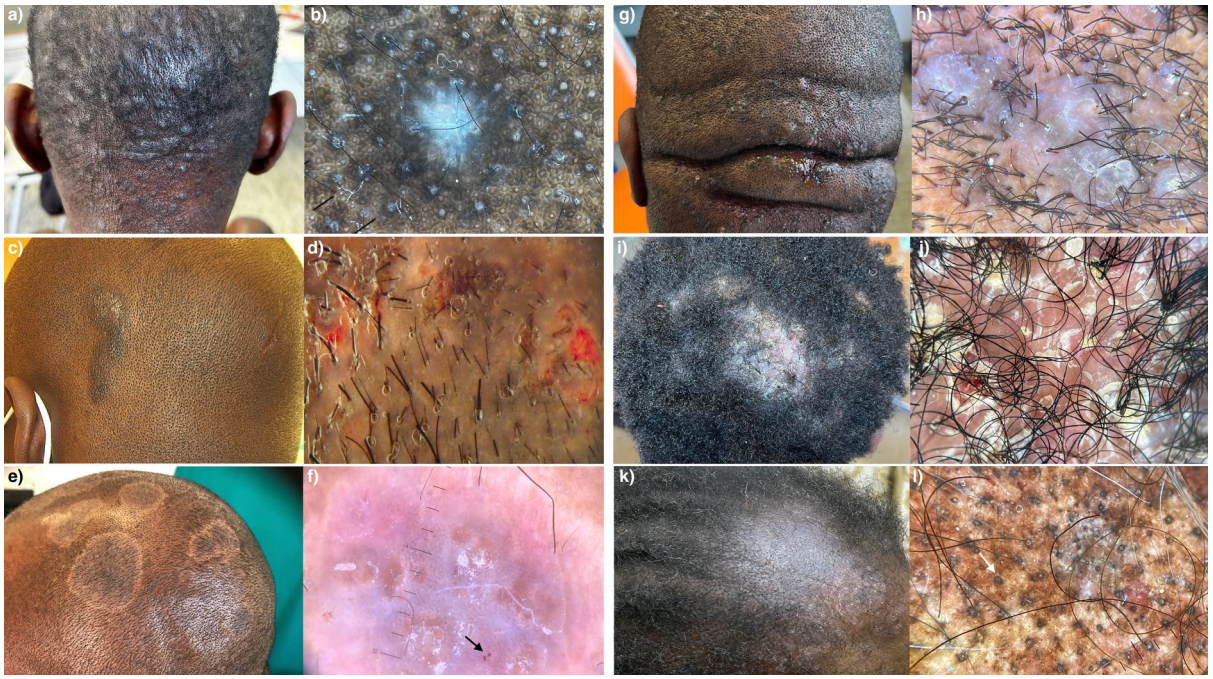

Fig. 2 Instances of lichen simplex chronicus/prurigo nodularis (**a**–**f**) compared to controls (**g**–**l**) in dark-skinned patients (phototypes IV–VI). Multiple firm papules/nodules of the scalp are shown on clinical examination (**a**); dermoscopic features include white lines in a peripheral-radial distribution (**b**). Clinical appearance of lichen simplex chronicus presenting as a dark brown scaly patch (**c**); erosions, hemorrhagic structureless areas and broken hairs are seen on dermoscopy examination (**d**). Multiple brown patches with a white halo on the scalp (**e**); dermoscopy displays multiglobular structures (cobblestone white pattern), erosions, broken hairs, and purpuric dots (black arrow) (**f**). Acne keloidalis nuchae: clinical image reveals papules localized on the occipital area of the scalp (**g**); dermoscopy shows bright white round areas (**h**). Clinical image of folliculitis decalvans (**i**); dermoscopic assessment reveals yellow tubular crusts, tufted hairs, and white scaling (**j**). Discoid lupus erythematosus: clinical picture (k); dermoscopy reveals follicular plugs (white arrow) and bright white structures (**l**)

possible marker of extra-scalp PN [8], while Starace et al. [7] found crusting, white areas, cloud vessels, and dystrophic hairs (broom-like hairs, along with split hairs, block hairs, and trichorrhexis nodosa) to be the most common findings in scalp LSC. Importantly, in our cohorts we did not observe dystrophic hairs other than broom-like shape, likely because in the previous study the authors used a higher magnification degree.

Differences between light and dark phototypes seen in our study are likely to be related to the different reaction patterns and cutaneous background, with fibrotic reactions being more common in dark-skinned individuals (with higher prevalence of white structures on dermoscopy) and brown background obscuring vascular structures. Furthermore, white structures are also easier to be appreciated against a darker skin background [9]. On the other hand, the higher tendency for scratch-induced skin thickening in skin of color may also explain the lower prevalence of perivascular white halos and follicular plugs compared to fair skin as they may be covered by skin acanthosis [2, 8, 9]. Additionally, the presence of follicular plugs is related to follicular hyperkeratosis, which is linked to repeated but more gentle scratching. It is well known that PN/LSC are more itchy in patients with skin of color than in fair skinned-patients, thereby possibly explaining the lack of statistically significance of such a dermoscopic finding in dark skin [2, 8, 9]. Of note, the broom-like hair pattern, which results from repeated mechanical breakage of hair shafts at various levels [6, 7], was

more prominent in fair skin, possibly due to differences in hair shaft morphology, with straight hairs being more prone to splitting.

From a dermoscopic-histological correlation point of view, purple structures would correspond to dermal extravasation of erythrocytes due to microvascular damage, sparse follicular plugs to focal follicular hyperkeratosis, dotted vessels (unspecific distribution) to vascular dilation in irregularly elongated dermal papillae (papillomatosis), perivascular white halo to acanthosis around the dermal papillae, white structures to acanthosis and dermal fibrosis (with horizontally arranged fibrotic bands at the periphery of the lesions resulting into peripheral radiating white lines on dermoscopy), and erosions to loss of epidermis/superficial dermis layers [1, 6].

Finally, the assessment of dermoscopic findings in PN/LSC of the scalp was found to be significantly reproducible according to inter-observer agreement analysis regardless of the phototype, thus supporting its use in clinical practice across all skin tones.

Limitations

The main limitations of the study include (I) the retrospective design, which is prone to recall and observation biases, which were addressed by involving evaluators who did not contribute to the sample collection; (II) the lack of dermoscopic-pathological correlation analysis; and (III) the potential variability introduced by having multiple investigators collecting the images at different centers, yet the use of the same dermoscopic device reduced the relevance of such a bias. Therefore, future studies addressing such points are needed to confirm our preliminary data.

CONCLUSIONS

Dermoscopy may be considered a possible supporting tool to facilitate the non-invasive recognition of PN/LSC of the scalp in both fair and dark skin. Besides the limited number of instances (especially for dark-skinned patients), the main limitations of the study include (I) its retrospective design, which is prone to recall and observation biases, which were addressed by involving evaluators who did not contribute to the sample collection; (II) the lack of dermoscopic-histological correlation study; and (III) the lack of subanalysis of PN and LSC lesions, yet their common clinical overlap may reduce the accuracy and reproducibility of such an evaluation. Future studies considering all these points are therefore needed to further validate our findings.

ACKNOWLEDGEMENTS

We thank the participants of the study

Authorship. All named authors meet the International Committee of Medical Journal Editors (ICMJE) criteria for authorship for this article, take responsibility for the integrity of the work as a whole, and have given their approval for this version to be published.

Author Contributions. Noemi Plozner: data collection, analysis, and drafting of the manuscript; Michela Lai: data collection, drafting and reviewing of the manuscript; Nkechi A Enechukwu: data collection, drafting and reviewing of the manuscript; Federico Quadrelli: data collection, drafting and reviewing of the manuscript; Giuseppe Stinco: data collection, drafting and reviewing of the manuscript; Bianca Maria Piraccini: data collection, drafting and reviewing of the manuscript; Michela Starace: data collection, drafting and reviewing of the manuscript; Enzo Errichetti: conceptualization, design and methodology design, statistical analysis, interpretation of results, and critical revision of the manuscript.

Funding. No funding or sponsorship was received for this study or publication of this article.

Data Availability. All data generated or analyzed during this study are included in the article.

Declarations

Conflict of Interest. Enzo Errichetti and Michela Starace are members of the Editorial Board of *Dermatology and Therapy*; they were not involved in the selection of peer reviewers for the manuscript nor any of the subsequent editorial decisions. Noemi Plozner, Michela Lai, Nkechi A Enechukwu, Federico Quadrelli, Giuseppe Stinco and Bianca Maria Piraccini have nothing to disclose.

Ethical Approval. The patients in this manuscript provided informed consent for the publication of case details and images, and institutional approval was not required, as the study was based on data retrospectively collected in a routine clinical setting, consistently with AIFA (Italian Medicines Agency) regulation (AIFA Determination, March 20, 2008). This study complies with the Declaration of Helsinki and no ethical approval was required as it results from routine clinical activity. Accessed data for the study complied with relevant data protection and privacy regulations.

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