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ORIGINAL PAPER

Evaluation of diagnostic accuracy of dermoscopy in some common hypopigmented skin diseases

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Abstract

Background Diagnosis of cutaneous hypopigmentation can sometimes be challenging. Dermoscopy may play a role in identifying hypo or-depigmented dermatoses. The aim was to investigate which dermoscopic criteria represent potent indicators for the diagnosis of vitiligo, nevus depigmentosus, pityriasis alba, hypopigmented pityriasis versicolor, idiopathic guttate hypomelanosis, hypopigmented mycosis fungoides (MF), lichen sclerosus et atrophicus and ash leaf hypopigmented macules of tuberous sclerosis, and evaluate their diagnostic accuracy. 168 individuals diagnosed with one of these hypopigmented disorders were evaluated for the presence or absence of predetermined dermoscopic criteria. Evaluation of dermatoscopic characteristics in each condition and analysis for sensitivity and specificity of dermatoscopic diagnosis in these hypopigmented lesions was performed. The starburst pattern, micro-koebnerization, and trichrome pattern were unique to vitiligo diagnosis. Vitiligo had higher comet-tail appearance, perifollicular pigmentation, and perilesional hyperpigmentation than other hypopigmented illnesses. Other hypopigmented lesions had greater incidence of amoeboid pattern, faint or diminished pigment network, islands of pigmentation, ill-defined boundaries, pseudopods, and widespread scaling than vitiligo. Finally, perifollicular scaling, comedo-like openings, blue-gray specks, and fibrotic regions excluded vitiligo. Dermoscopy can help identify common hypopigmented skin lesions and reduce the need for skin biopsy. Nevus depigmentosus, pityriasis alba and idiopathic guttate hypomelanosis were the top three hypopigmented dermatoses that could be diagnosed by dermoscopy with 100% sensitivity. Vitiligo was in the second rank (94.7%), followed by lichen sclerosis et atrophicus (93.3%) then hypopigmented MF at 81.2% sensitivity. Dermoscopy sensitivity was lowest in pityriasis versicolor and ash leaf macules of tuberous sclerosis (52.6% and 46.7%, respectively).

Keywords Hypopigmented skin diseases · Diagnosis · Dermoscopy · Sensitivity · Specificity

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Introduction

Macular or patchy hypopigmented skin lesions are frequently met complaints in dermatology clinics. They can be highly upsetting for the patients, especially if they have dark skin. Dermoscopic characteristics of vitiligo have been described widely in literature, whereas only few reports are available for description of dermoscopic changes in other hypopigmented dermatoses [1]. The aim of this work was to investigate which dermoscopic criteria represent potent indicators for the diagnosis of commonly encountered hypopigmented disorders namely vitiligo, nevus depigmentosus (ND), pityriasis alba (PA), hypopigmented pityriasis versicolor (PVC), idiopathic guttate hypomelanosis (IGH), hypopigmented mycosis fungoides (MF), lichen sclerosus et atrophicus (LSEA) and ash leaf hypopigmented macules of tuberous sclerosis (ALS), and evaluate their diagnostic accuracy in comparison to their clinicopathological diagnosis.

Materials and methods

This is an observational cross-sectional analytical study.

Patients

Two hundred and fifty patients of all ages and both sexes presenting with hypopigmented skin lesions were included. Patients were recruited from the outpatient clinics of the Dermatology and Venereology Department - Tanta University Hospitals in the period between August 2019 and March 2023. They had at least 1 clinically hypopigmented skin lesion of either vitiligo, ND, PA, hypopigmented PVC, LSEA, or ALS, and their final diagnosis was confirmed based on clinical, pathological and immunohistochemical examination. Among the 250 patients examined, 82 patients were excluded from participation in the study as they lacked definite clinicopathological diagnoses of the 8 diseases of concern. The minimum number of patients collected for each diagnosis was 15, to be appropriate for statistical analysis of sensitivity and specificity of dermoscopy in the diagnosis of each hypopigmented disorder. The research protocol was approved by the institutional review board of the ethical committee of the Faculty of Medicine-Tanta University prior to patient enrolment (Approval code 32926/02/19).

Dermoscopic evaluation

The single, most recently developed lesion in every patient was examined dermoscopically using dermoscope; Dermlite 4 (4Gen, San Juan Capistrano, CA, USA). Dermoscopic images were taken in polarized mode with precautions taken to reduce compression artifacts. Dermoscopic photos of every patient (without any clinical data except for patient's age and lesion site) were randomly listed from number 1 to the last case. Evaluation of the randomly listed dermoscopic photos was performed by two researchers; both were blinded to the clinicopathological diagnoses. A comprehensive list of all dermoscopic structures described and published in previous research up till year 2023 was compiled (Table 1). The search was performed on Pubmed and Google scholar for comprehensive review articles, observational clinical studies, and retrospective studies for the 8 disorders. Each dermoscopic image was evaluated for the presence or absence of those predetermined dermoscopic criteria. Pigment network was evaluated to determine if it was absent, faint, or reduced, in addition to perifollicular pigmentation, and islands of pigmentation. Borders of lesions were assessed for being well or ill-defined in addition to the presence of pseudopods/ serrations, or perilesional hyperpigmentation. Hair color within the lesion was evaluated. Vascular structures were defined as erythema/ linear/comma/dotted blood vessels. Presence of scaling and scales characteristics were evaluated (diffuse, or perifollicular) in addition to peppering blue-gray dots, comedo-like openings, and fibrotic areas.

Statistical analysis of the data

The collected data were organized, tabulated, and statistically analyzed using SPSS (Statistical Package for Social Studies) version 26 created by IBM, Illinois, Chicago, USA. For numerical values, the range, mean, and standard deviation were calculated. For categorical variables, the number and percentage were calculated and differences between subcategories were tested by chi-square or Monte Carlo exact test. The agreement between the two diagnostic techniques (clinicopathological & dermoscopic diagnosis) was tested by the Kappa test. The level of significance was adopted at $P < 0.05$. For each disease, the sensitivity and specificity of dermatoscopic diagnosis were calculated.

Results

The patients were 78 men (46.4%) and 90 women (53.6%). Their ages varied from 6 months to 70 years, with a mean ± SD of 21.78 years ± 18.28. The duration of hypopigmented skin lesions ranged from 1 week to 30 years. Fitzpatrick's skin types included were Type II (in 7 patients), Type III (in 87 patients), and Type IV (74 patients).

Table 1 A comprehensive list of dermoscopic findings for the 8 hypopigmented skin lesions of concern published in previous research:

Disease	Dermoscopic findings	Disease	Dermoscopic findings
Vitiligo	**Unstable (active) vitiligo** 1. - Residual perifollicular pigmentation on a background of depigmentation [3]. 2. - Altered pigment network [absent, reduced (generalized diminshing of pigment network all over the lesion), reverse] [3, 4]. 3. - Starburst pattern, Comet tail appearance (a curvilinear short extension from the lesion edge), Micro-Koebner's phenomenon (a long comet tail), Tapioca sago appearance (pearly white globules), nebulous pattern (relating to, or resembling a nebula: not clear not sharp or vague), amoeboid pattern, trichrome pattern (a tan zone of varying width between normal and depigmented skin) [1, 3]. **Stable vitiligo** 1. - Leukotrichia [3]. 2. - Perifollicular depigmentation [3]. **Repigmenting vitiligo** 1. - Perifollicular pigmentation [3]. 2. - Marginal hyperpigmentation [3].	**Depigmented nevus**	1.- Hypopigmented patch with an irregular serrated border [1, 8]. 2.- Pseudopods pattern protruding into the normal skin [1, 8]. 3.- Faint reticular network [1, 8]. 4.- Normal hair color, white hairs rarely present [1]. 5.- No peripheral hyperpigmentation [1].
Hypopigmented pityriasis versicolor	1- - Hypopigmented blotches "well- defined" with faint pigment network and fine scales (in the skin furrows, focal, perifollicular or perilesional) scales in the skin furrows detach from the skin and breaks into two parts when the lesions are stretched "**doubleedged**" [15]. 2- - No perilesional hyperpigmentation or perifollicular hyperpigmentation [1]. 3- - Normal hair color covered by scales [1].	**Pityriasis alba**	1- - Hypopigmented macules "ill demarcated" with faint pigment network and fine scales (within and outside macules) [1]. 2- - Erythematous changes within and surrounding macules [18].
Extragenital lichen sclerosis et atrophicus	**Early lesions** 1- - White structureless areas [1]. 2- - Comedolike openings [1, 21]. 3- - Peppered grayblue and brown dots (accumulation of very small blue-gray dots throughout the lesion) [22]. 4- - Linear branching vessels, linear irregular vessels, dotted vessels, comma-like vessels, hairpin vessels [22]. **Late lesions** 1- - White structureless areas (loss of pigment network) with chrysalis strands are seen with chrysalis strands (fibrotic bands, rounded or longitudinal glistening fibrotic structures) [22].	**Idiopathic guttate hypomelanosis**	1- - Multiple, shiny, porcelain-white macules with well- and ill-defined edges borders (may coalesce into polycyclic macules) [1]. 2- - Hyperpigmented networks within the lesions or surrounding skin giving the appearance of the cloudy-sky pattern [1, 14]. 3.- Petaloid, amoeboid, feathery, nebulous and polka dot patterns (smaller lesions near or arising from the edges of a principal lesion) [14–16].
Hypopigmented mycosis fungoides	1- - Broken pigmentary network in hypopigmented areas [12]. 2-	**Ash leaf macules of tuberous sclerosis**	1.- Reduced pigment network (alternating white areas corresponding to areas of complete pigment loss with areas with faint pigmentation) [24].

The incidence of agreement of dermoscopic diagnosis with confirmed diagnosis in the 168 hypopigmented lesions examined was 86.3% (Table 2).

The sensitivity and specificity of dermoscopic examination in diagnosis of the 8 included hypopigmented dermatoses are shown in Table 3. Dermoscopy was able to distinguish ND, IGH, and PA with 100% sensitivity. Vitiligo followed at 94.7% sensitivity, then LSEA (93.3%) ensued by hypopigmented MF (81.2%). Hypopigmented PVC and ALS were the least predicted by dermoscopy with 52.6% and 46.7% sensitivity, respectively. The typical repetition of specific findings in ND, IGH, and PA lesions might be the explanation. IGH and vitiligo showed specificity of 99.3% and 98.5%. This was likely owing to the distinct dermoscopic features in each disease.

Dermoscopic signs of the studied hypopigmented skin lesions are listed by frequency in Table 4. The most prevalent dermoscopic findings in vitiligo were white structureless patches (92.1%), well-defined borders (81.6%), and absent pigment network (78.9%). The starburst pattern (21.1%), trichrome pattern (15.8%), and micro-koebnerization phenomena (5.3%) were exclusively seen in vitiligo, making them highly specific findings. In the present research, perifollicular pigmentation was more common in vitiligo lesions, but it was also detected in ND and LSEA lesions (26.3% vs. 8.6% and 6.7%, respectively).

Table 2 Incidence of agreement and disagreement of dermatoscopic diagnosis with confirmed clinicopathologic diagnosis in individual hypopigmented skin lesions examined

Clinicopathological diagnosis *N* (%)		Agreement of dermoscopic diagnosis	Disagreement of dermoscopic diagnosis
		N (% within the corresponding diagnosis)	*N* (% within the corresponding diagnosis)
Vitiligo	38 (22.6) • Active (clinically) 23(60.5) • Stable (clinically) 10(26.3) • Repigmenting(clini-cally) 5(13.2)	36 (94.7)	2 (5.3)
Depigmented nevus	36 (21.4)	35 (97.2)	1 (2.8)
Hypopigmented mycosis fungoides	16 (9.5)	12 (75)	4 (25)
Idiopathic guttate hypomelanosis	16 (9.5)	16 (100)	0
Pityriasis alba	15 (8.9)	15 (100)	0
Hypopigmented pityriasis versicolor	17 (10.1)	10 (58.8)	7 (41.2)
Lichen sclerosis et atrophicus	15 (8.9)	14 (93.3)	1 (6.7)
Ash macule leaf of tuberous sclerosis	15 (8.9)	7 (46.7)	8 (53.3)
Total	**168 (100)**	**145 (86.3)**	**23 (13.7)**

Pseudopods/serrated (88.6%), well-defined borders (74.3%), faint (57.1%), and decreased pigment network (42.9%) were the most prevalent dermoscopic characteristics of ND.

The most prevalent dermatoscopic criteria for hypopigmented MF were weak pigment network, ill-defined borders in 87.5% of lesions, and spermatozoa-like blood vessels (38.5%).

Well-defined boundaries (86.7%), amoeboid pattern (80%), and decreased pigment network (66.7%) were the most common dermoscopic findings in IGH lesions in the present study.

In this research, weak pigment network (100%), ill-defined pigment network (100%), diffuse scaling (66.7%), and erythematous background (46.7%) strongly suggested PA diagnosis.

The most prevalent characteristics of hypopigmented PVC were weak pigment network (100%) and well-defined borders (94.1%). Although common in PA, scaling was seen in just 31.6% of PVC cases.

The most prevalent dermoscopic features for LSEA were white structureless areas (100%), fibrotic beams (86.7%), and comedo-like openings (80%). Comedo like openings were detected in inflammatory stage while white structurless areas were found in the late sclerotic stage of LSEA.

All ALS lesions in this study showed decreased pigment network, ill-defined and serrated borders.

Figures 1-2 illustrate the clinical, histopathological and dermoscopic findings of some included patients

Discussion

Our work sheds light on dermoscopy's ability to assist diagnosis of hypopigmented skin lesions. The incidence of agreement between the dermoscopic diagnosis and the clinicopathological diagnosis in the present study was 86.3% of instants with P value less than 0.001. In terms of dermoscopy's sensitivity and specificity in the current study, among the eight hypopigmented disorders included, ND, IGH, and PA were the top three diseases that could be identified with dermoscopy with 100% sensitivity. Vitiligo (94.7%) came in the second rank, followed by LSEA (93.3%). Dermoscopy was least predictive for hypopigmented PVC and ALS, with 52.6% and 46.7% sensitivity, respectively. This might be explained by the repetition of an assortment of certain features in lesions of ND, IGH, and PA. In the other instances, dermoscopy was deemed a good positive test in IGH and vitiligo, with specificities of 99.3% and 98.5%, respectively. This is most likely due to the occurrence of unique dermoscopic findings in each condition.

According to previous literature white structureless regions were the most common dermoscopic findings in vitiligo [2]. Stable vitiligo had well-defined borders and absent network, while perifollicular pigmentations was claimed to characterize active disease. Perifollicular pigmentation is the most common form of vitiligo pigmentation [3], while evolving vitiligo presented with a decreased pigment network [4]. Absence of melanocytes and epidermal pigmentations in vitiligo, [5] may explain why absent network and white structureless patches were the most prevalent criteria in this research. The previously described CD4 and CD8 lymphocytic cells infiltration detected at the borders of vitiligo lesions may explain the clear demarcation between the lesion and the surrounding skin [6].

Table 3 Sensitivity and specificity of dermoscopy in relation to clinicopathologic diagnosis in diagnosis of hypopigmented lesions of concern

Dermatoscopic diagnosis	Clinico-pathological diagnosis															
	Vitiligo		Depigmented nevus		Hypopigmented mycosis fungoides		Idiopathic guttate hypomelanosis		Pityriasis alba		Pityriasis versicolor		Lichen sclerosis et atrophicus		Ash leaf macule of tuberous sclerosis	
	Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative
	N (%)	*N* (%)	*N* (%)	*N* (%)	*N* (%)	*N* (%)	*N* (%)	*N* (%)	*N* (%)	*N* (%)	*N* (%)	*N* (%)	*N* (%)	*N* (%)	*N* (%)	*N* (%)
Positive	36 (94.7)	2 (1.5)	35 (97.2)	12 (9)	13 (81.2)	4 (2.6)	16 (100)	1 (0.07)	15 (100)	4 (2.6)	10 (58.8)	10 (6.7)	14 (93.3)	14 (9.2)	7 (46.7)	7 (4.6)
Negative	2 (5.3)	128 (98.5)	1 (2.8)	120 (91)	3 (18.8)	14 (97.4)	0	151 (99.3)	0	149 (97.4)	7 (41.2)	139 (93.3)	1 (6.7)	139 (90.8)	8 (53.3)	146 (95.4)
Total	38 (100)	130 (100)	36 (100)	132 (100)	16 (100)	152 (100)	16 (100)	152 (100)	15 (100)	153 (100)	17 (100)	149 (100)	15 (100)	153 (100)	15 (100)	153 (100)
Sensitivity (true positives/true positives + false negatives)	94.7%		97.2%		81.2%		100%		100%		58.8%		93.3%		46.7%	
Specificity (true negatives/true negatives + false positives)	98.5%		91%		97.4%		99.3%		97.4%		93.3%		90.8%		95.4%	

Despite their prevalence in vitiligo, some of included hypopigmented dermatoses showed absent pigment network, white structureless patches, or clearly defined borders. Thus, despite their sensitivity, they were not exclusively diagnostic for vitiligo. This contradicted the previous belief that considered that perifollicular pigmentation was exclusive for vitiligo [7].

Pseudopods/serrated (88.6%), well-defined borders (74.3%), faint (57.1%), and decreased pigment network (42.9%) were the most prevalent dermoscopic characteristics of ND. Many authors mentioned that ND diagnostic dermoscopic criteria were a weak pigment network and faint borders [1, 8]. Melanosome transport failure from melanocytes to keratinocytes causes hypopigmentation in ND, not complete pigment loss. Melanosomes are usually normal in size, shape, and internal structure, but they can be reduced in number, heteromorphic, aggregated in melanocytes, or found in membrane-bound aggregates [9]. Few melanosomes transfer into keratinocytes [10]. This may explain the ND pigment network findings in this study which was diffusely or intermittently faint depending on the fraction of abnormal to normal melanosomes and their growth stage.

Perifollicular pigmentation was seen in 8.6% of ND lesions in a prior study [8]. Leukotrichia was found in 17.1% of ND lesions, contradicting the idea that pigmentation around hair follicles was diagnostic for vitiligo. In contrast, prior study reported normal hair colour in all ND lesions [1]. Islands of pigmentation within ND lesions were commonly encountered in this research (detected in 31.4% of lesions examined), although others did not consider it as a dermoscopic diagnostic key in ND diagnosis [11].

Previously reported dermoscopic findings of hypopigmented MF were faint pigment network and spermatozoa-like blood vessels, and decreased pigment network [12]. Hypopigmentation in hypopigmented MF has been considered the extreme result of a protective immune response caused by neoplastic or reactive CD8 T cells in cellular infiltrates [13]. Our research found that ill-defined borders and weak pigment network are frequent in other hypopigmented skin disorders as well as hypopigmented MF, therefore dermoscopy is not conclusive in detecting it (81.2% sensitivity).

Former studies reported that the most prevalent dermoscopic patterns in IGH lesions were amoeboid/feathery patterns (46.66%/40% respectively) with defined borders [14, 15]. Pigment network loss and the three distinct patterns (amoeboid, petaloid with well-defined borders, cloudy sky/nebulous with ill-defined borders) were characteristic of IGH, [16] with the cloudy sky pattern being the most common one [1]. The diminished pigment network in IGH lesions might be attributed to the patchy distribution of melanocytes and melanin [17]. Although some of these patterns are seen in other hypopigmentary disorders, dermoscopy is more sensitive in diagnosing IGH due to its unique features. The present study's distinctive petaloid pattern in IGH made it highly selective for its distinction (sensitivity 100%, specificity 99.3%).

The dermoscopic signs of PA lesions observed in our study were weak pigment network (100%), ill-defined pigment network (100%), diffuse scaling (66.7%), and erythematous background (46.7%), which were consistent with those reported in previous literature, mainly including faint pigment network, ill-defined borders, and scaling in PA lesions [1, 18].

The most prevalent characteristics of hypopigmented PVC were weak pigment network (100%) and well-defined borders (94.1%). Although common in PA, scaling was seen in just 31.6% of PVC cases. This was consistent with studies that found hypopigmented PVC had faint pigment network with well-defined borders. They stressed the relevance of scales in PVC distinction, which was contrary to our findings (only 31.6% of hypopigmented PVC lesions) [1, 19]. Others found scales along the dermatoglyphics in 87% of hypopigmented PVC lesions and 66% of mixed lesions, and folliculocentric in 66.7% [1, 19, 20]. In this study, polarised mode of dermoscopy might be the cause obscuring PVC lesion scales.

Hypopigmented PVC and PA might be clinically similar, especially in adolescents and individuals with facial PVC, therefore dermoscopy may be beneficial in distinguishing them. Only the well-established borders distinguished hypopigmented PVC and PA dermoscopically in our study.

LSEA diagnosis relied on comedo-like openings, and other prior research indicated the high frequency of crystalline structures, fibrotic patches, or beams [1, 21]. Deep dermal fibrosis and follicular plugging [22], may explain the frequency of fibrotic regions and comedo-like openings.

The current study found 46.7% of LSEA lesions presenting with blue-gray patches and this distinctive dermoscopic finding could be attributed to the vacuolar basal cell layer degeneration and upper dermis melanophages, which are extremely specific for LSEA compared to other hypopigmented illnesses [23].

All ALS lesions in this investigation showed decreased pigment network, ill-defined and serrated borders. These results confirmed previous observations, although sparse, that ALS lesions had uneven, ill-defined borders with alternating patches of missing and weak network [8]. Histopathologic evaluation of ALS lesions shows normal melanocyte density despite a significant epidermal melanin pigment reduction.

Clinically, isolated ALS and ND are difficult to identify since both exhibit irregular round or polygonal macules, segmental distribution, and leucotrichia. Histopathologically,

Table 4 Dermoscopic finding and their frequency in different hypopigmented dermatoses included in the study in addition to characteristic findings for vitiligo

Dermatoscopic findings		Vitiligo	Depigmented nevi	Hypopigmented mycosis fungoides	Idiopathic guttate hypopmelanosis	Pityriasis alba	Hypopigmented pityriasis versicolor	Lichen sclerosis et atrophicus	Ash leaf macule of tuberous sclerosis	*P* value (for x^2 test comparing different included dermatoses)
		N=38 (%)	*N*=36 (%)	*N*=16 (%)	*N*=15 (%)	*N*=15 (%)	*N*=17 (%)	*N*=16 (%)	*N*=15 (%)	
Patterns of pigmentation	White structureless area	**37 (97.4)**	10 (28.6)	1 (6.3)	7 (46.7)	0	0	**15 (100.0)**	13 (86.7)	<0.001*
	Starburst appearance	***8 (21.1)***	0	0	0	0	0	0	0	0.001*
	Satellite lesions	11 (28.9)	6 (17.1)	0	1 (6.7)	0	0	1 (6.7)	0	0.001*
	Comet tail appearance	*9 (23.7)*	3 (8.6)	0	1 (6.7)	0	0	0	0	0.004*
	Micro-kobener phenomenon	***2 (5.3)***	0	0	0	0	0	0	0	0.404
	Nebulous pattern	0	1 (2.9)	1 (6.3)	4 (26.7)	0	0	0	0	0.010*
	Ameboid pattern	3 (7.9)	6 (17.1)	0	**12 (80.0)**	0	0	0	0	<0.001*
	Petaloid pattern	0	0	0	6 (40.0)	0	0	0	0	<0.001*
	Trichrome pattern	***6 (15.8)***	0	0	0	0	0	1 (6.7)	0	0.046*
Pigment network	Faint pigment network	1 (2.6)	**20 (57.1)**	**14 (87.5)**	7 (46.7)	**15 (100.0)**	**17 (100.0)**	0	1 (6.7)	<0.001*
	Reduced pigment network	7 (18.4)	**15 (42.9)**	2 (12.5)	**10 (66.7)**	0	0	9 (60.0)	**15 (100.0)**	<0.001*
	Absent pigment network	**30 (78.9)**	1 (2.9)	0	5 (33.3)	0	0	6 (40.0)	0	<0.001*
	Perifollicular pigmentation	*11 (28.9)*	3 (8.6)	0	0	0	0	1 (6.7)	0	0.001*
	Islands of pigmentation	9 (23.7)	11 (31.4)	0	0	0	1 (5.3)	3 (20.0)	0	0.001*
Border	Well defined border	**32 (84.2)**	**26 (74.3)**	2 (12.5)	**13 (86.7)**	0	**16 (94.1)**	6 (40.0)	0	<0.001*
	Ill-defined border	6 (15.8)	9 (25.7)	**14 (87.5)**	6 (40.0)	**15 (100.0)**	2 (10.5)	8 (53.3)	**15 (100.0)**	<0.001*
	Perilesional hyperpigmentation	*15 (39.5)*	0	0	1 (6.7)	0	1 (5.3)	0	0	<0.001*
	Pseudopods	7 (18.4)	**31 (88.6)**	0	3 (20.0)	0	0	0	**15 (100.0)**	<0.001*
Leukotrichia		9 (23.7)	6 (17.1)	1 (6.3)	0	0	1 (5.3)	1 (6.7)	0	0.071
Vascular structures		20 (52.6)	2 (5.7)	**6 (38.5)**	0	7 (46.7)	6 (31.6)	9 (60.00)	0	<0.001*
Others	Diffuse scaling	1 (2.6)	0	0	1 (6.7)	**10 (66.7)**	6 (31.6)	3 (20.0)	0	<0.001*
	Perifollicular scaling	0	0	0	0	1 (6.7)	0	2 (13.3)	0	0.029*
	Peppering blue-grey dots	0	0	0	0	0	0	**12 (80.0)**	0	<0.001*
	Comedo like openings	0	0	0	0	0	0	7 (46.7)	0	<0.001*
	Fibrotic beams	0	0	0	0	0	0	**13 (86.7)**	0	<0.001*

Results in bold denote the most frequent findings in included dermatoses, results with *Italic* indicated the findings that are more frequent in vitiligo than other hypopigmented skin disorders ***Bold Italic*** indicates the exclusive findings of vitiligo, x^2=Chi square, * = Significant at P value <0.05

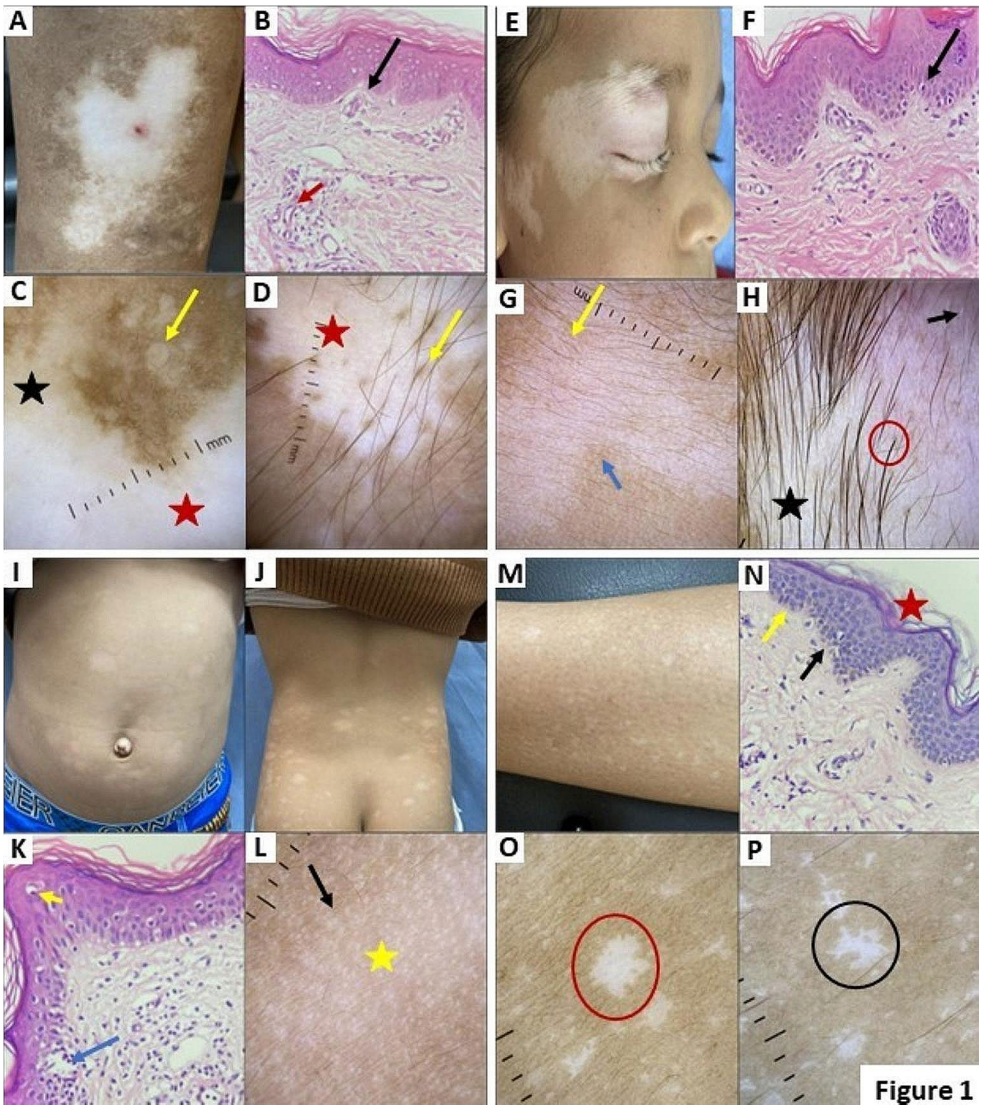

Fig. 1 **A**: 40 years old female patient with active vitiligo on the left leg, **B**: Histopathology with no basal melanocytes nor melanin pigment *(Black arrow)* with perivascular lymphocytic infiltrate in the dermis *(Red arrow)* (H&E x200), **C**: Dermoscopy of vitiligo with white structureless areas *(Red star)* satellite lesions *(Yellow arrows)*, trichrome pattern *(Black star)*, and well-defined border (x10), **D**: Dermoscopy with white structureless areas (*Red star*), perifollicular hyperpigmentation *(Yellow arrows)*, and absent pigment network (x10), **E**: 4 years old female child with nevus depigmentosus on the right side of the face, **F**: Histopathology with normal basal melanocytes and absence of melanin pigment *(Black arrow)* (H&E x200), **G**, **H**: Dermoscopy showing white structureless areas *(Black star)*, reduced pigment network, perifollicular pigmentation *(Red circles)*, islands of pigmentation within the lesion *(Yellow arrows)*, well-defined serrated border *(Blue arrow)*, and leucotrichia *(Black arrow)* (x10), **I**, **J**: Male child aged 7 years with Hypopigmented mycosis fungoides of 4 months duration, **K**: Histopathological examination of the hypopigmented MF lesion with epidermotropism *(Yellow arrow)* and pautrier microabcess *(Blue arrow)* in the non-spongiotic epidermis, alignment of atypical lymphocytes along dermo-epidermal junction and their presence in the dermis (H&E x100), **L**: Dermoscopy with ill-defined border *(Black arrow)* and faint pigment network *(Yellow star)* (x10), **M**: 45 years old female patient with idiopathic guttate hypomelanosis on the left leg of 3 years duration, **N**: Histopathology with orthokeratotic skin *(Red star)*, epidermal atrophy, flattening of rete ridges *(Yellow arrow)* with few melanin globules in the epidermis *(Black arrow)* (H&E x40), **O**, **P**: Dermoscopic pictures with reduced pigment network, petaloid *(Red circle)*, amoeboid patterns *(Black circle)*, and well-defined borders (x10)

both can have normal or reduced melanocyte numbers [24]. Dermoscopically, ND lesions with a faint network are easily distinguished from ALS lesions, which have always had a decreased pigment network. When diminished pigment network presented in ND lesions, ND and ALS differed solely in the borders, which were well-defined in ND but always ill-defined in ALS.

This study showed that dermoscopy can help specifying vitiligo from other hypopigmented disorders. The starburst pattern, micro-koebnerization, and trichrome pattern were

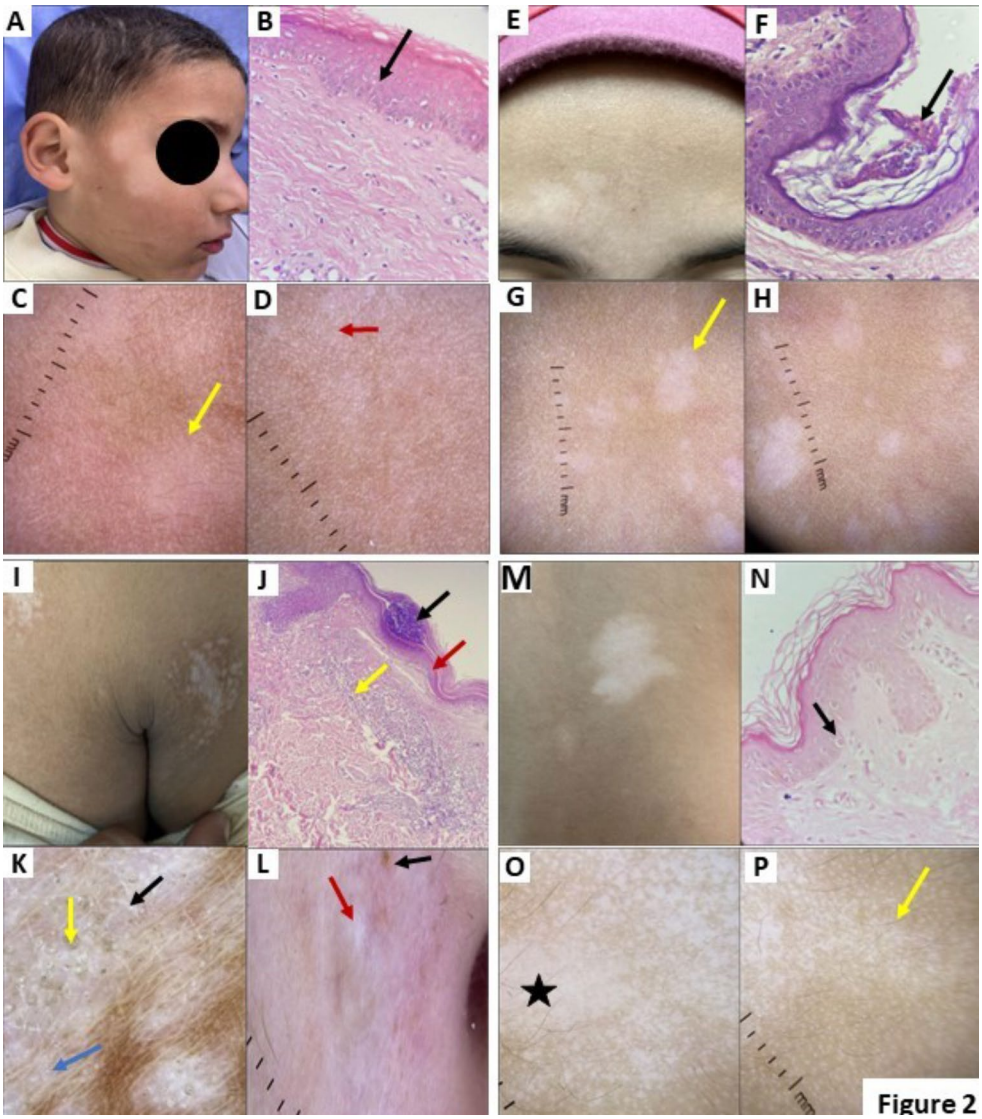

Fig. 2 **A**: 4 years old male child with pityriasis alba on the face, **B**: Histopathology with acanthosis, spongiosis *(Black arrow)*, and reduction in basal melanin (H&E x200), **C**, **D**: Dermoscopic pictures with ill-defined borders *(Yellow arrow)*, faint pigment network, erythema, and diffuse scaling *(Red arrow)* (x10). **E**: 18 years old female patient with hypopigmented pityriasis versicolor on the forehead for 2 weeks, **F**: Histopathology showing spores and hyphae in the upper layers of stratum corneum *(Black arrow)* (H&E x200), **G**, **H**: Dermoscopic pictures of the lesion with well-defined borders *(Yellow arrow)*, faint pigment network (x10), **I**: 45 years male patient with lichen sclerosis et atrophicus on the left shoulder of 6 months duration, **J**: Histopathology with hyperkeratosis, follicular plugging *(Black arrow)*, atrophic flattening of the epidermis *(Red arrow)*, and hyalinization of the upper dermis with lymphocytic infiltration *(Yellow arrow)* (H&E x40), **K**: Dermoscopy of lichen sclerosis et atrophicus lesion with well-defined borders, white structureless areas, reduced pigment network, comedo-like openings *(Yellow arrow)*, fibrotic beams *(Black arrow)*, and peppering blue-gray dots *(Blue arrow)* (x10). **L**: Dermoscopic picture with well-defined borders, areas of fibrosis *(Red arrow)*, reduced pigment network, comedo-like openings *(Black arrow)*, and erythema with variable intensity on the background (x10). **M**: 8 years old male child with ash leaf macule of tuberous sclerosis on the back, **N**: Histopathology showing melanocytes in the basal layer of the epidermis with few melanin globules *(Black arrows)* (H&E x200), **O**, **P**: Dermoscopic pictures of ash leaf macule lesion with ill-defined serrated borders *(Yellow arrow)*, white structureless areas *(Black star)*, and reduced pigment network (x10)

unique to vitiligo diagnosis. Vitiligo had higher comet-tail appearance, perifollicular pigmentation, and perilesional hyperpigmentation than other hypopigmented lesions. Other hypopigmented dermatoses have greater incidence of amoeboid pattern, faint pigment network, diminished pigment network, islands of pigmentation, ill-defined borders, pseudopods, and widespread scaling than vitiligo. Finally, perifollicular scaling, comedo-like openings, blue-grey specks, and fibrotic patches excluded vitiligo.

The research limitations include being a single-centre study with only Egyptian Caucasian participants, most of whom were Fitzpatrick skin types III and IV. Ethnic,

regional, and phototype variables might alter clinical and dermoscopic pictures of hypopigmented skin lesions, hence bigger population-based, multicenter investigations with patients of diverse races are required. Second, this study did not include other hypo or depigmenting skin conditions, such as post-eruptive hypopigmentation, progressive macular hypomelanosis, leprosy, and chemical-induced leukoderma. Therefore, extending similar studies to additional hypo or depigmented dermatoses would be valuable.

Conclusion

Dermoscopy can help sensitively identify common hypopigmented skin lesions and reduce the need for skin biopsy, particularly in misleading cases of IGH, PA, and ND. Dermoscopy yields specific findings which could assist in the diagnosis and differentiation of vitiligo, hypopigmented MF, IGH, and PA. It is extremely useful in distinguishing vitiligo from other hypopigmented dermatoses. If diagnostic doubt remains with dermoscopy then the lesion should be biopsied. Unfortunately, in some hypopigmented lesions of nevus depigmentosus, pityriasis alba, and hypopigmented pityriasis versicolor, histopathological examination is of limited diagnostic value. In cases of diagnostic confusion, it is more important to combine the appearance of the lesions, medical history or other non-invasive examination methods such as Wood's lamp examination and reflectance confocal microscopy. There are some limitations to dermoscopy.

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Declarations

Competing interests The authors declare no competing interests.

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