

Dermoscopy of Infectious Dermatoses (Infectiouscopy) in Skin of Color – A Systematic Review by the International Dermoscopy Society “Imaging in Skin of Color” Task Force

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ABSTRACT Dermoscopy has been showed to facilitate the non-invasive recognition of several infectious disorders (infectiouscopy) thanks to the detection of peculiar clues. Although most of the knowledge on this topic comes from studies involving light-skinned patients, there is growing evidence about its use also in dark phototypes. This systematic literature review summarizes published data on dermoscopy of parasitic, bacterial, viral and fungal dermatoses (dermoscopic findings, used setting, pathological correlation, and level of evidence of studies) and provides a homogeneous terminology of reported dermoscopic features according to a standardized methodology. A total of 66 papers addressing 41 different dermatoses (14 bacterial, 5 viral, 11 fungal infections, and 11 parasitoses/bites and stings) and involving a total of 1096 instances were included in the analysis. The majority of them displayed a level of evidence of V (44 single case reports and 21 case series), with only 1 study showing a level of evidence of IV (case-control analysis). Moreover, our analysis also highlighted a high variability in the terminology used in the retrieved studies. Thus, although promising, further studies designed according to a systematic and standardized approach are needed for better characterization of dermoscopy of infectious skin infections.

Introduction

The group of infectious skin disorders encompass a wide number of conditions due to parasitic, bacterial, viral and fungal agents [1-3]. Whereas the use of dermoscopy was initially conceived for parasitoses and insect bites/stings, there has been a significant increase of publication also on non-parasitic cutaneous infections [3]. Thanks to the detection of peculiar clues, dermoscopic assessment may help the clinician promptly recognize some infectious dermatoses without the use of time-consuming and expensive investigations (e.g., microbiological, laboratory, or imaging tests) [1-3]. Of note, most of studies dealing with dermoscopy of infectious dermatoses involved light-skinned patients [1-3], yet there is a growing trend in publications focusing on dark phototypes (Fitzpatrick’s phototypes IV-VI) [3,4].

This systematic review, performed on behalf of the *International Dermoscopy Society* (IDS) Task Force on “Imaging in Skin of Color”, aimed at providing for the first time an up-to-date systematic analysis on dermoscopy of infectious dermatoses (infectiouscopy) in skin of color, also trying to align dermoscopic terminology of reported findings following a homogeneous standardized nomenclature.

Methods

This systematic review was performed in accordance with the *PRISMA* (Preferred Reporting Items for Systematic Reviews and MetaAnalyses) guidelines. A search of the articles published up to 30th June 2022 was performed through

the *PubMed* electronic database using the following search terms: “dermoscopy” OR “epiluminescence” OR “dermatology” AND “skin of color” OR “dark skin” OR “black skin” OR “ethnic skin” OR “dark phototype” OR “african skin” OR “indian skin”. Titles and abstracts were screened by two independent reviewers to identify papers reporting dermoscopic findings of skin infestations, insect bites/stings, bacterial, viral and fungal skin infections; articles dealing with hair, nail, and mucosal conditions were not considered and non-English articles, reviews, personal opinions/editorials and duplicates were excluded. A manual search was also performed by assessing the reference sections of all significant studies or reviews on this topic.

Articles deemed not relevant and those not mentioning dermoscopic structures according to specific dermatosis/number of patients with particular dermoscopic structures were excluded after full-text reading. Only articles specifically dealing with Fitzpatrick’s phototypes IV-VI were included. In case information on the skin phototype was not provided, decision on inclusion was made based on a title/abstract/full text showing that the manuscript concerned “dark skin” or “skin of color” and for single cases also based on the attached figures. We also included papers from African, Indian subcontinent, and Caribbean countries as most of patients from these areas feature IV-VI skin phototype. Notably, studies grouping light and dark phototypes without dedicated subanalyses were excluded.

All of the retrieved studies were classified based on standard definitions for diagnostic accuracy studies [5,6] and their level of evidence was assigned according to *The Oxford*

2011 Levels of Evidence [7]. Dermoscopic findings, histopathological background (if available), dermoscopic setting (polarized *vs* non-polarized/magnification degree), skin type of the patient (if specified), and number of cases were assessed and summarized. Additionally, standardized terminology based on the IDS dermoscopic criteria for non-neoplastic dermatoses validated for skin of color was specified for each dermoscopic finding reported in the literature [8].

Results

The initial *PubMed* search showed 1287 publications, whereas 49 were added following additional reference screening, with a total of 82 items admitted to the full-text reading after title and abstract screening and excluding duplicates. Of these, 16 papers were ruled out based on the exclusion criteria, with 66 articles being eventually in the review process. The flow chart showing the study selection procedure is depicted in Figure 1.

The full-text review included 44 single case-reports, 21 case-series, and one case-control study, with the last one being the only analysis with a higher level of evidence (IV), while the rest of the studies had the lowest level of evidence (V). Forty-one different dermatoses (also accounting for relevant disease variants with clinical/dermoscopic peculiarities) were analyzed, including 14 bacterial, 5 viral, 11 fungal infections, and 11 parasitoses/bites and stings; a total of 1096 instances were retrieved. Table 1 shows the number of studies and total number of included patients for each condition.

Dermoscopic setting (polarized *vs* non-polarized) was reported in 46/66 records (40 polarized; 1 non-polarized; 5 both), magnification in 49/66 records (31: x10

magnification; 4: x16 magnification; 5: x20 magnification; 4: x50 magnification; 2: x200 magnification; 3: variable magnification), and dermoscopic-pathological correlation in 33/66 records. Supplemental Table summarizes all such data, along with analytical description of each of the study evaluated in the review (number of patients, type of study and level of evidence), dermoscopic features, skin phototype, and corresponding terminology according to the IDS dermoscopic criteria for non-neoplastic dermatoses validated for skin of color. Table 1 also shows the general prevalence (calculated from all data reported in the literature) of dermoscopic findings of included conditions for which a standardized terminology was available. Relevant findings for each dermatosis are reported as follows; for practical purpose, we have grouped them according to the etiological agent. Figures 2-6 show dermoscopic clues of such conditions.

Bacterial Infections

Leprosy

Leprosy is the bacterial disease with the greatest amount of data about the use of dermoscopy for diagnostic purposes, with a total of 12 published studies (1 case-control analysis, 6 case-series, and 5 single case-reports) [9-20]. Dermoscopic patterns of the entire spectrum of leprosy has been described in skin of color, with the commonest findings (reported in all subtypes) including yellow/yellowish-orange areas, paucity of appendageal structures (eccrine dots and hairs), and vessels (mainly linear vessels with branches) [9-20]. Additionally, Ankad *et al* found white structureless areas to be another frequent feature in borderline tuberculoid leprosy in a cohort of 12 patients [11]. Reduced pigment network was also observed in all subtypes, apart from lepromatous

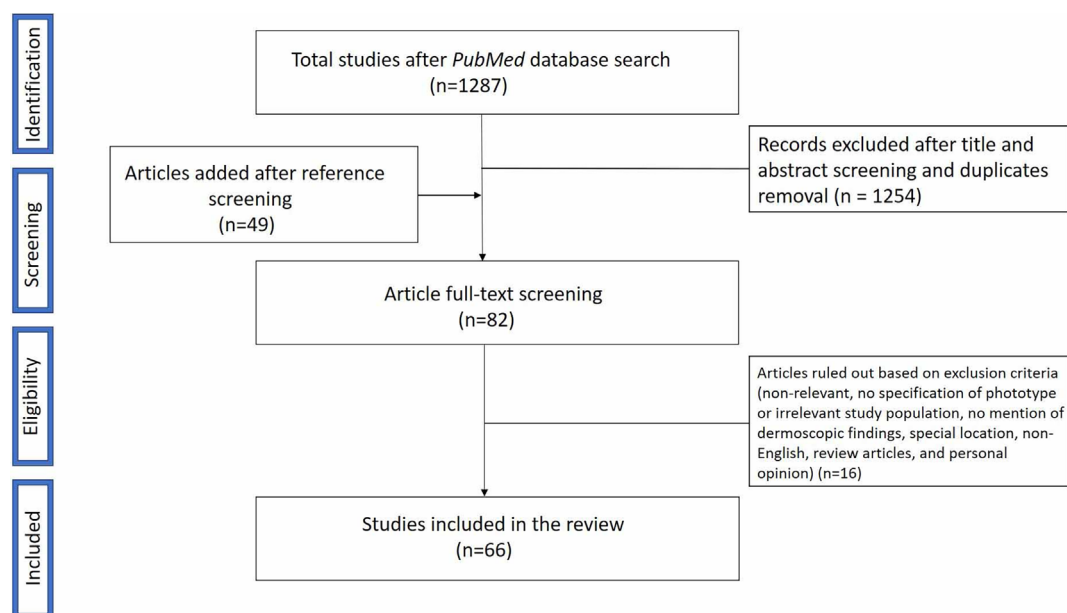


Figure 1. PRISMA flowchart displaying the selection process for study inclusion in the systematic review.

Table 1. Total Number of Studies, Instances and of Standardized Dermoscopic Findings of Infectious Dermatoses in Skin of Color.

Dermatoses	Total Number of Studies	Total Number of Instances (Instances With Dermoscopy Prevalence Data)	Dermoscopic Findings* (Total Prevalence)**
Bacterial infections			
<i>Leprosy</i>			
<i>Borderline tuberculoid</i>	4	63 (12)	<i>Common findings:</i> White structureless areas (100%); Yellow globules (67%); Reduction of eccrine gland openings (50%) <i>Less common findings:</i> Linear vessels with branches (33%)
<i>Tuberculoid</i>	2	6 (0)	-
<i>Borderline lepromatous</i>	2	27 (0)	-
<i>Lepromatous</i>	5	35 (2)	<i>Common findings:</i> Peripheral linear vessels with branches (100%); Yellow structureless areas (50%); Orange/brown globules (50%) <i>Less common findings:</i> -
<i>Type 1 reaction</i>	4	34 (14)	<i>Common findings:</i> Vessels: linear with branches (71%); Orange structureless areas (57%) <i>Less common findings:</i> Yellow-orange structureless areas (43%); Vessels: linear (29%)
<i>Type 2 reaction</i>	4	23 (1)	<i>Common findings:</i> Brown dots and globules (100%) <i>Less common findings:</i> -
<i>Histoid leprosy</i>	5	12 (6)	<i>Common findings:</i> Vessels: linear with branches (83%); Yellow/orange structureless areas (67%) <i>Less common findings:</i> White scales (33%); Follicular plugs (33%); White structureless areas (17%); Vessels: linear curved (17%); White-yellow structureless areas (17%); Peripheral brown structureless areas (17%); Peripheral linear vessels with branches (17%)
<i>Hypopigmented leprosy</i>	1	11 (11)	<i>Common findings:</i> Reduction of skin appendages (82%); White structureless areas (73%); Brown lines, brown reticular lines (73%) <i>Less common findings:</i> Perifollicular white color (36%)
<i>Leprosy (non-specified variants)</i>	1	13 (13)	<i>Common findings:</i> Structureless areas: focal white (92%); Reduction of skin appendages (85%) <i>Less common findings:</i> Scales: white patchy (46%); Vessels: linear with branches (31%); Brown dots (31%); Structureless areas: orange (23%); Lines: brown (23%); Vessels: linear (23%); Vessels: dotted (15%); Structureless areas: brown (8%); Vessels: linear curved (8%); Lines: white (8%); Brown globules (8%)
<i>Lichen scrofulosorum</i>	2	3 (3)	<i>Common findings:</i> Perifollicular white colour (100%); Follicular plug (67%); Peripheral white scales (67%) <i>Less common findings:</i> Diffuse white scales (33%); Perifollicular hyperpigmentation (33%)

Dermatoses	Total Number of Studies	Total Number of Instances With Dermoscopy Prevalence Data)	Dermoscopic Findings* (Total Prevalence)**
<i>Lupus vulgaris</i>	2	31 (31)	<p><i>Common findings:</i> Linear vessels (77%); Dotted vessels (71%); Yellow/white globules (61%); White structureless areas (61%); Scales: white, yellow (61%)</p> <p><i>Less common findings:</i> White lines (39%); Structureless areas: bright white focal (36%)</p> <p><i>Scales:</i> white patchy (26%); Structureless areas: orange focal (23%); Yellow scales/crusts (19%); Follicular plugs (16%); Structureless areas: brown focal (13%); Globules: white (13%), brown (13%); Vessels: linear with branches (10%); Brown dots (10%); Lines: brown (10%); White circles (10%); Blue structureless areas (6%); Vessels: linear curved (3%)</p>
<i>Syphilis (secondary)</i>	1	1 (1)	<p><i>Common findings:</i> White scales (100%); Peripheral scales (100%); Orange structureless area (100%)</p> <p><i>Less common findings:</i> -</p>
<i>Trichomycosis axillaris</i>	1	1 (1)	<p><i>Common findings:</i> Yellow concretions around hair shafts (100%)</p> <p><i>Less common findings:</i> -</p>
<i>Tuberculosis verrucosa cutis</i>	1	1 (1)	<p><i>Common findings:</i> Yellow structureless area (diffuse) (100%); White scales (100%); Yellow/orange globules and structureless areas (100%)</p> <p><i>Less common findings:</i> -</p>
Viral infections			
<i>Molluscum contagiosum</i>	4	32 (12)	<p><i>Common findings:</i> White globules (83%)</p> <p><i>Less common findings:</i> Vessels: peripheral dotted (42%); Linear vessels with branches, peripheral (33%); White to yellow focal structureless area (8%); Peripheral linear vessels with branches and dotted vessels (8%)</p>
<i>Plane warts</i>	2	12 (12)	<p><i>Common findings:</i> Brown structureless area (diffuse) (83%); Dotted vessels (83%)</p> <p><i>Less common findings:</i> Brown dots over a white background (17%); Interruption of skin markings (17%)</p>
<i>Palmoplantar warts</i>	4	197 (151)	<p><i>Common findings:</i> Interruption of skin markings (100%); Dotted vessels (52%); Papillae (47%); Yellow, brown structureless area (diffuse) (39%)</p> <p><i>Less common findings:</i> Purple dots (13%); Linear vessels (13%)</p>
<i>Common warts</i>	4	123 (123)	<p><i>Common findings:</i> -</p> <p><i>Less common findings:</i> Papillae (34%); Brown dots (24%); Dotted vessels (19%); Brown structureless area (diffuse) (17%); Dotted or curved linear vessels (11%); Vessels: thrombosed (11%); Purple dots (11%); Yellow structureless area (9%); Interruption of skin markings (7%); White structureless area (7%); Blue structureless area (4%); Linear vessels (3%); Linear curved vessels (2%)</p>
<i>Genital warts</i>	1	2 (2)	<p><i>Common findings:</i> Vessels: dotted (100%), linear (50%); Blue structureless area (diffuse) (50%)</p> <p><i>Less common findings:</i> -</p>

Table 1. Total Number of Studies, Instances and of Standardized Dermoscopic Findings of Infectious Dermatoses in Skin of Color. (continued)

Dermatoses	Total Number of Studies	Total Number of Instances (Instances With Dermoscopy Prevalence Data)	Dermoscopic Findings* (Total Prevalence)**
Fungal infections			
<i>Chromoblastomycosis</i>	4	4 (4)	<i>Common findings:</i> Yellow–orange structureless areas (50%); White scales (50%); Yellow crusts (50%); White lines (50%) <i>Less common findings:</i> Yellow scales (25%); Dotted vessels (25%); Linear-curved vessels (25%); Brown dots/globules (25%); Yellow structureless areas (25%); White structureless areas (25%)
<i>Mycetoma</i>	3	3 (3)	<i>Common findings:</i> White scales (67%) <i>Less common findings:</i> Yellow globules (33%); White structureless areas (33%); Dotted vessels (33%); Yellow structureless areas (33%); Brown/white globules (33%); Small black grains (33%); Blue-white structureless areas (33%)
<i>Pityriasis versicolor Hypopigmented</i>	3	199 (199)	<i>Common findings:</i> - <i>Less common findings:</i> White scales: patchy (48%); White scales: in skin furrows (24%); White scales: perifollicular (10%); White scales (10%); White scales: diffuse (7%); Vessels: linear branching (7%); White scales: patchy in skin furrows (5%); White scales: peripheral (5%); Perifollicular white color (3%); Vessels: dotted (2%)
<i>Hyperpigmented</i>	3	54 (54)	<i>Common findings:</i> White scales (63%) <i>Less common findings:</i> Scales (28%); white diffuse/patchy (26%); Structureless areas: brown (19%); White scales: in skin furrows (13%); Structureless areas: focal (11%); White scales: diffuse (9%); Lines: brown (9%); White scales: patchy (7%); Structureless areas: diffuse (7%); Perifollicular white color (4%); White scales: perifollicular (2%)
<i>Pityrosporum folliculitis</i>	2	60 (60)	<i>Common findings:</i> Follicular papules/pustules (100%); Vessels: dotted, linear with branches, linear curved (67%); Hypopigmentation of hair shaft (63%); Diffuse white scales (58%); Coiled to looped hairs (57%) <i>Less common findings:</i> Perifollicular white scales (18%)
<i>Rhinofacial entomophthoromycosis</i>	1	1 (1)	<i>Common findings:</i> Focal yellow/orange structureless areas (100%); Dotted and linear vessels (100%); White structureless areas (100%); Scales (100%); Yellow dots (100%) <i>Less common findings:</i> -
<i>Sporotrichosis</i>	2	5 (5)	<i>Common findings:</i> Yellow–orange structureless areas (80%); Linear vessels (60%) <i>Less common findings:</i> Yellow structureless areas (20%); Linear vessels with branches (20%); White structureless areas (focal) (20%); Peripheral-radiating white lines (20%); Follicular plugs (20%)

Dermatoses	Total Number of Studies	Total Number of Instances (Instances With Dermoscopy Prevalence Data)	Dermoscopic Findings* (Total Prevalence)**
<i>Tinea corporis</i>	2	43 (43)	<i>Common findings:</i> White scales (100%) <i>Less common findings:</i> Scaly broken hairs (37%); White scales: peripheral (jagged outer free edge) (2.3%); Structureless areas: brown (21%) focal (14%)/diffuse (7%); Brown dots (14%); Brown scales: peripheral (12%); Broken hairs (9%); White scales: jagged mixed free edge (7%); Vessels: dotted (5%); White scales: perifollicular (5%); Yellow scales/crusts: peripheral (5%); Structureless areas: focal white (2%)
<i>Tinea incognita</i>	3	53 (53)	<i>Common findings:</i> <i>Less common findings:</i> Morse code vellus hairs (34%); Follicular pustules (26%); Peripheral white scales (26%); Micropustules at the borders (22%); Linear, linear curved, dotted vessels (20%); Purple areas (18%); Perifollicular scales (2%); Black dots (2%); Dystrophic broken hairs (2%); Dotted vessels (2%)
<i>Tinea manuum/pedis</i>	2	11 (11)	<i>Common findings:</i> White scales (91%) <i>Less common findings:</i> White scales in the skin furrows (9%); Dotted vessels in the skin furrows (9%)
<i>White piedra</i>	1	1 (1)	<i>Common findings:</i> Creamy yellow nodules distributed along the hair at irregular interval (100%) <i>Less common findings:</i> -
Parasitoses/bites and stings			
<i>Bed bug bites</i>	1	1 (1)	<i>Common findings:</i> Purple dot (100%) <i>Less common findings:</i> -
<i>Cydnidae pigmentation</i>	4	4 (4)	<i>Common findings:</i> Brown lines (50%) <i>Less common findings:</i> Brown dots/globules (2.5%); Brown dots (2.5%); Brown dots/lines (2.5%); Brown structureless area (diffuse) (2.5%); Perifollicular pigmentation (2.5%)
<i>Cutaneous larva migrans</i>	1	1 (1)	<i>Common findings:</i> Well-defined, segmented yellow-white linear structure (100%); Brown dots with peripheral white scales (100%) <i>Less common findings:</i> -
<i>Cutaneous leishmaniasis</i>	3	17 (17)	<i>Common findings:</i> Follicular plugs (71%); White lines (65%); Ulceration (53%) <i>Less common findings:</i> Vessels: dotted (35%), linear (35%); Structureless areas: focal orange (35%); Structureless areas: white (24%); Vessels: linear with branches (18%); Peripheral-radiating white lines (12%); Vessels (12%); linear, linear-curved

Table1 continues

Table 1. Total Number of Studies, Instances and of Standardized Dermoscopic Findings of Infectious Dermatoses in Skin of Color.

Dermatoses	Total Number of Studies	Total Number of Instances (Instances With Dermoscopy Prevalence Data)	Dermoscopic Findings* (Total Prevalence)**
<i>Gamasidosis</i>	1	1 (1)	<i>Common findings:</i> Mite red to black in color engorged with blood (100%) <i>Less common findings:</i> -
<i>Pediculosis</i>			
<i>Pediculosis capitis</i>	1	1 (1)	<i>Common findings:</i> Empty nits (grey, translucent, ovoid eggs with flattened free ends) attached to the hair shaft (100%) <i>Less common findings:</i> -
<i>Pediculosis pubis</i>	3	3 (3)	<i>Common findings:</i> Nits containing unhatched nymphs, translucent empty cases (33%); Active lice (33%); Nits attached to eyelashes (33%); Crab-shaped pubic lice with thick claws grasping hair shaft (33%) <i>Less common findings:</i> -
<i>Post-kala azar leishmaniasis</i>	3	3 (2)	<i>Common findings:</i> Follicular plugs (50%); Yellow structureless areas (50%) <i>Less common findings:</i> -
<i>Tick bite</i>	1	1 (1)	<i>Common findings:</i> Tick with four pairs of limbs (100%) <i>Less common findings:</i> -
<i>Tungiasis</i>	1	1 (1)	<i>Common findings:</i> Central brown ring, central pore, and faint pigmented peripheral ring (100%); Peripheral white structureless area (100%) <i>Less common findings:</i> -
<i>Wound myiasis</i>	1	1 (1)	<i>Common findings:</i> Larvae, caudal larval end with two oval openings, incomplete peritreme and prominent slits (100%) <i>Less common findings:</i> -

*Dermoscopic findings for which a standardized terminology was available; the se are divided into common (prevalence $\geq 50\%$) and less common (prevalence $< 50\%$)

**Total prevalence is calculated only considering studies for which prevalence data of dermoscopic findings was available

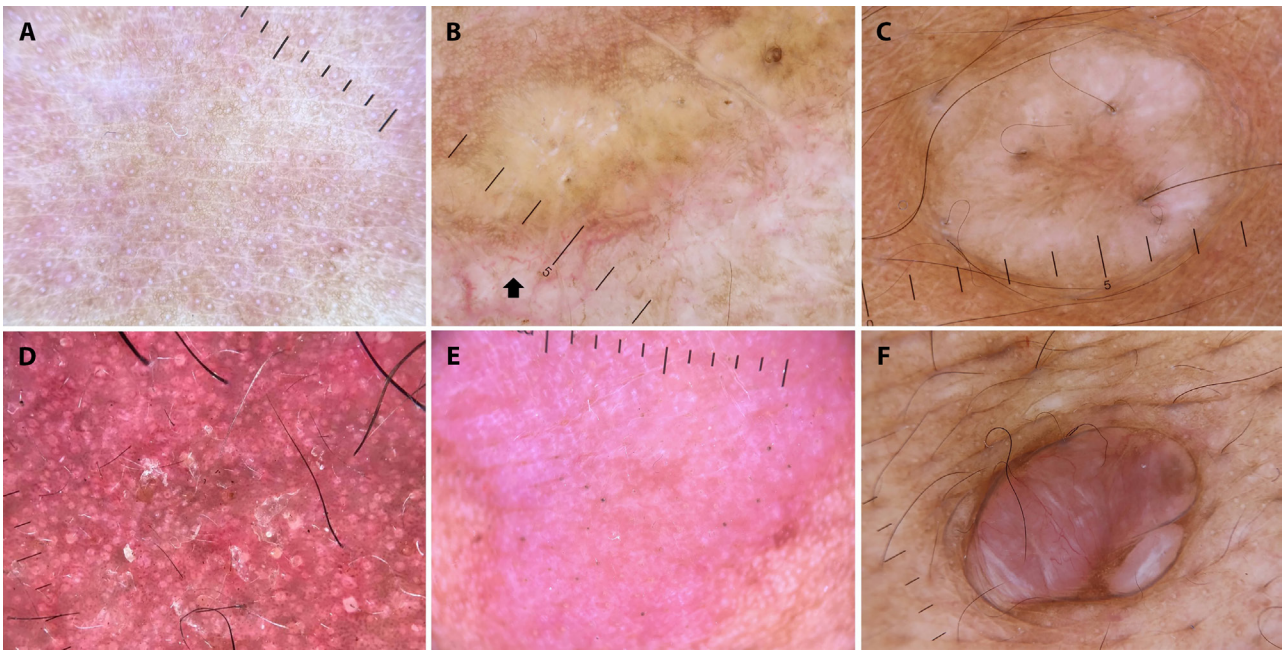


Figure 2. Examples of dermoscopic clues of bacterial diseases in dark-skinned patients: White structureless areas and reduction of eccrine gland openings in borderline tuberculoid leprosy (Courtesy of Matilde Krisha Montenegro, MD and Katherine Joy Sayo, MD – Manila, Philippines) (A); Yellow structureless areas along with white structureless areas, faint peripheral linear vessels with branches (arrow), and reduction of skin appendages (hairs/eccrine glands openings) in borderline lepromatous leprosy (B); Loss of pigment network along with white areas and reduction of eccrine glands openings and hair follicles in lepromatous leprosy (C); Reduction of skin appendages, erythema, white scales and follicular plugs in Type-1 lepromatous reaction (D); Homogenous white-pink area and brown-gray dots in Type-2 lepromatous reaction (Courtesy of Matilde Krisha Montenegro, MD and Katherine Joy Sayo, MD – Manila, Philippines) (E); Elongated linear vessels with branches and multiple white structureless areas in histoid leprosy (F).

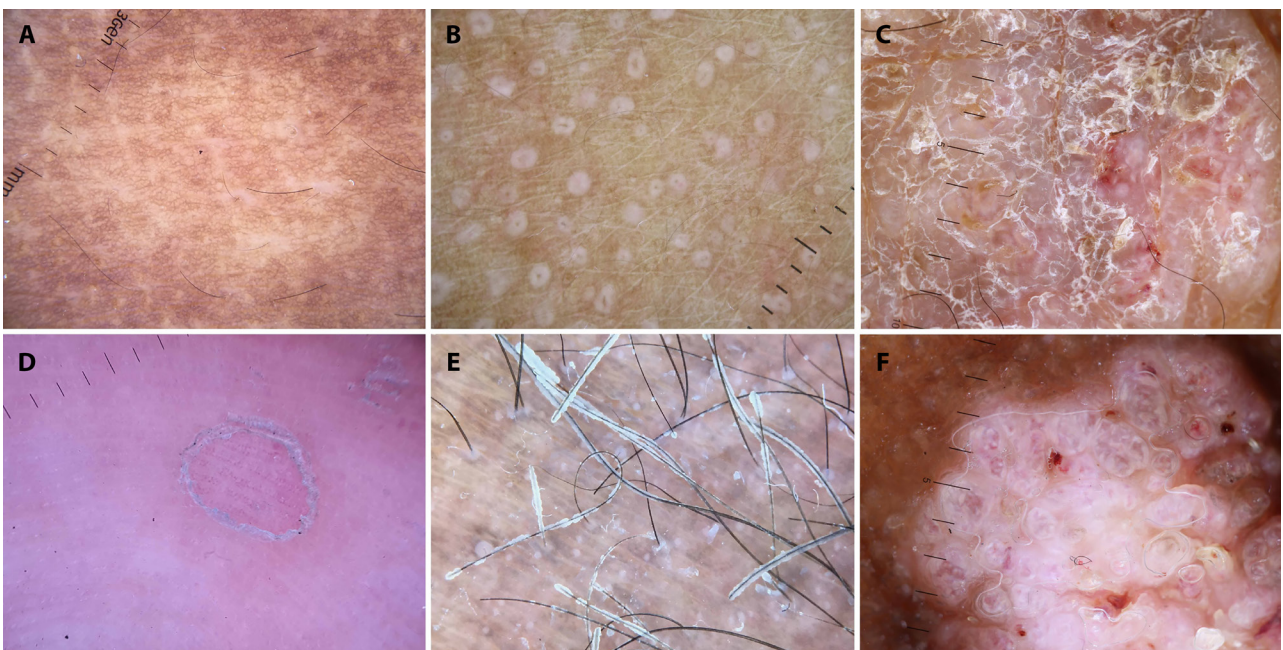


Figure 3. Examples of dermoscopic clues of bacterial diseases in dark-skinned patients: Ill-defined white structureless area and reduction of skin appendages in hypopigmented leprosy (A); Follicular plugs with perifollicular white color in lichen scrofulosorum (B); Orange-yellow and bright white globules/structureless areas along with diffuse white scaling in lupus vulgaris (C); Peripheral white collarette scaling in palmar secondary syphilis (D); Yellow concretions around the hair shafts in trichomycosis axillaris (E); Multiple white globules (papillae) centered by dotted vessels in tuberculosis verrucosa cutis (F).

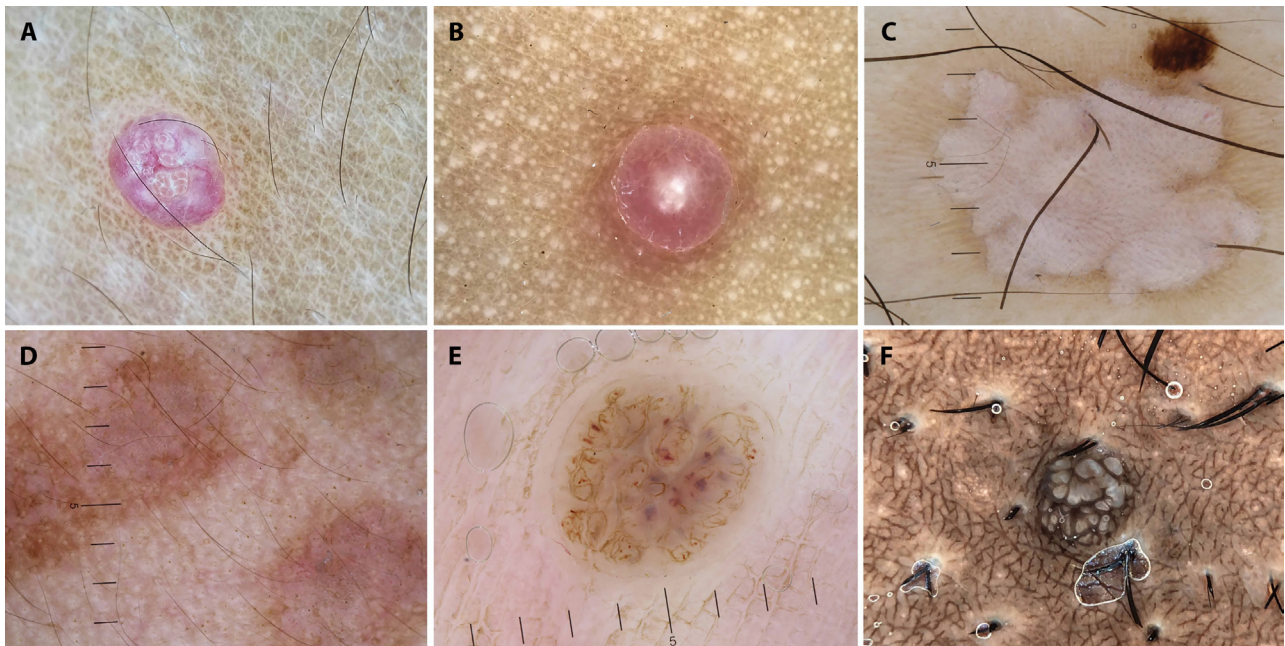


Figure 4. Examples of dermoscopic clues of viral diseases in dark-skinned patients: Multiple yellow-white globules and peripheral linear vessels with branches in molluscum contagiosum (A); Central pore surrounded by white globules/dots along with peripheral dotted vessels in molluscum contagiosum (B); Brown dots and dotted vessels over a white background in a plane wart (C); Brown structureless area (diffuse) and few dotted vessels in plane warts (D); Interruption of skin markings, dotted vessels and diffuse brown pigmentation in a common wart (E); Multiple grey papillae in a genital wart (F).

leprosy, in which an accentuation of pigment network secondary to basal layer pigmentation was described [10,12]. Finally, Mohta *et al* found relative sparing of vellus hair in tuberculoid pole, whereas focal areas of hyperpigmentation with loss of pigment network were seen in borderline lepromatous cases [12].

Moving to lepromatous reactions, four studies (case-series/reports) exist for both type-1 reaction (T1R) [10,12,13,16] and type-2 reaction (T2R) [10,12,13,17]. The most common dermoscopic features of T1R were dilated vessels (mainly linear with branches), white scales, follicular plugs, and white/yellow-orange structureless areas [10,13,16], while T2R has been described to show mainly hyperpigmentation (shape/color not specified) and dilated linear vessels with branches [10,12,13,17]. Recently, homogeneous white-pink structureless area with irregular border having a crumpled fabric appearance with peripheral brown-gray dots/globules was noted in an instance of bullous T2R [17]. Notably, dermoscopic findings characteristic of underlying leprosy subtype have also been described in reactional states [10,12,13,16,17].

Considering histoid leprosy, five studies have been reported (case-series/reports), with white/white-yellow and yellowish orange structureless areas being the main dermoscopic features. Additional findings included shiny white

structures (structureless or linear areas), yellowish-brown to pink structureless areas, peripheral hyperpigmentation, scaling, follicular plugs and vessels (linear with branches or linear-curved) [10,12,18-20]. Finally, regarding hypopigmented forms of leprosy, Errichetti *et al* reported that reduction of skin appendages was a clue to differentiate them from other hypopigmented dermatoses in a case-control study [9].

Lichen Scrofulosorum

Dermoscopy of lichen scrofulosorum has been investigated in two reports and described findings included monomorphic, grouped, brown follicular plugs along with pale halos as well as a peripheral white scales, marginal hyperpigmentation, and dilated vessels [21,22].

Lupus Vulgaris

Data about dermoscopy of lupus vulgaris (LV) comes from a case-control analysis by Errichetti *et al* involving 12 patients [9] and a case-series on 19 instances by Ankad *et al* [23]. Yellow-orange structureless areas (mainly focal), linear vessels (mainly with an unspecific distribution), white scales, and focal bright white (fibrotic) structureless areas were the most frequent findings. Of note, Errichetti *et al* found that the presence of focal bright white areas was typical of LV when compared with other granulomatous diseases, including sarcoidosis.

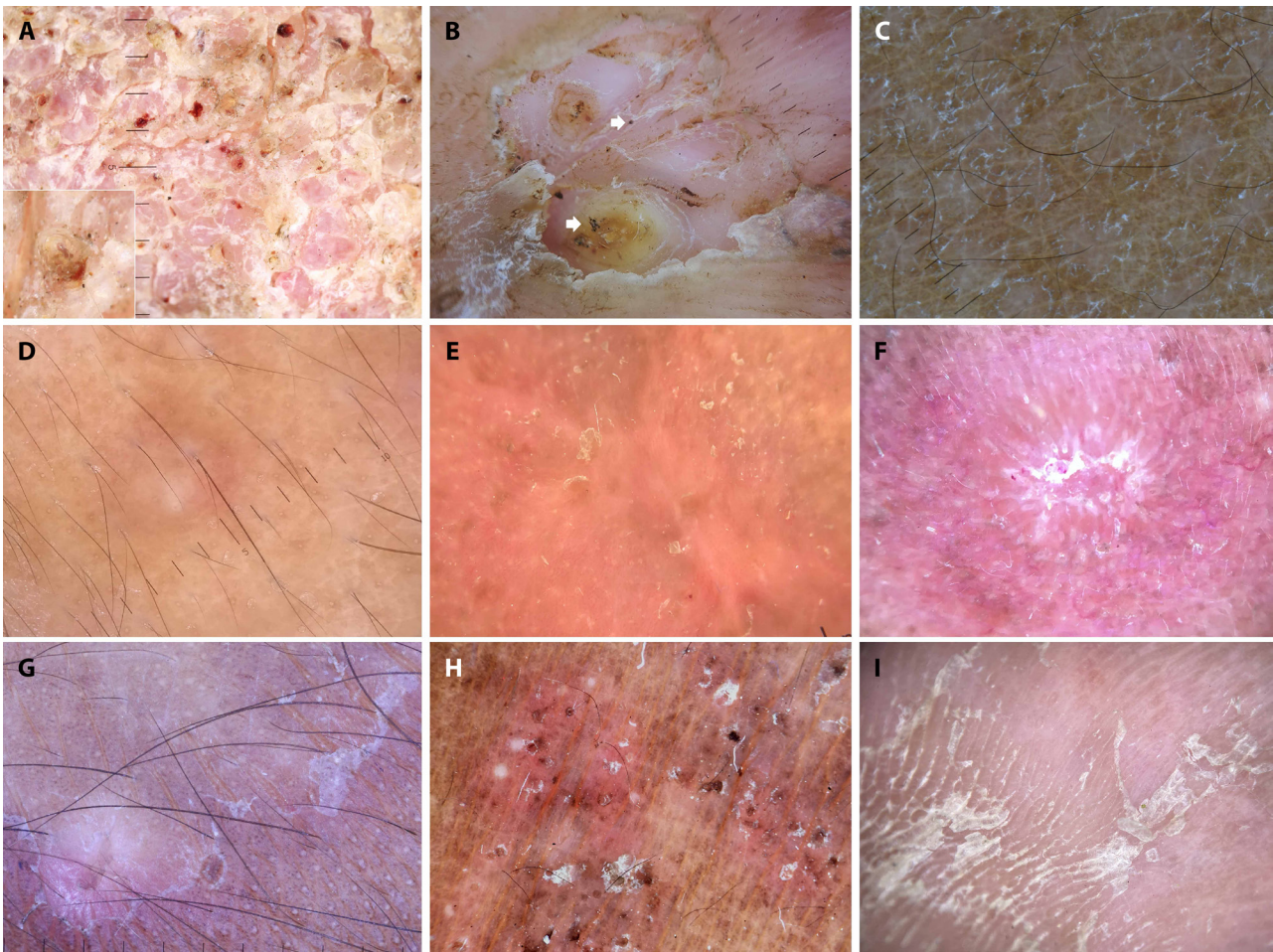


Figure 5. Examples of dermoscopic clues of fungal diseases in dark-skinned patients: White and yellow scaling/crusting, dotted vessels and purple (hemorrhagic) dots/globules along with yellow structureless areas and brown dots (better visible in the inset) in chromoblastomycosis (A); White scales, yellow and white structureless areas, and black grains (dots) (arrow) in mycetoma (B); Perifollicular white color along with white scales in the skin furrows in hypopigmented pityriasis versicolor (C); Folliculocentric pale papule in *Pityrosporum* folliculitis (D); Focal orange and white structureless areas and white scales in rhinofacial entomophthoromycosis (E); Follicular plugs and unfocused linear vessels over an orange-erythematous background in sporotrichosis (adapted from *Dermoscopy in General Dermatology for Skin of Color*, Errichetti E, Lallas A, eds. CRC Press 2021) (F); White peripheral collarette scaling with a jagged mixed (outer and inner) free edge in tinea corporis (G); Follicular pustules, perifollicular scaling/crusting and dystrophic broken hairs in tinea incognito (H); White scales in the skin furrows in tinea manuum (I).

Syphilis

A single report on dermoscopy of syphilis is available for skin of color [24]. The authors evaluated an instance of secondary syphilis and found ill-defined, brown structureless area fading towards the periphery along with white scaling in the skin furrows in body lesions, while an orange structureless area and white scaling were reported in palmar lesions [24].

Trichobacteriosis Axillaris

A single dermoscopic description of trichobacteriosis axillaris does exist, with detection of golden yellow concretions encasing multiple hair shafts along their length [25].

Tuberculosis Verrucosa Cutis

Only a single report describing dermoscopy of tuberculosis verrucosa cutis is available in the literature, with

yellow-orange globules and structureless areas, papillated surface, dirty white thick scales, and irregularly dilated vessels being observed [26].

Viral Infections

Molluscum Contagiosum

Four studies are available when it comes dermoscopy of molluscum contagiosum (one case-control study, one case series and two single reports) [9,27-29]. Most data comes from the case-control study by Errichetti *et al* involving 10 instances that showed white globules to be the main feature [9], in line with other reports [27,28]. Additional findings included peripheral dotted or linear vessels with branches [9,27,28]. Of note, white globules with visible vessels running across the surface were also reported by Daruwalla *et al*, who performed extraction dermoscopy in 20 patients [29].

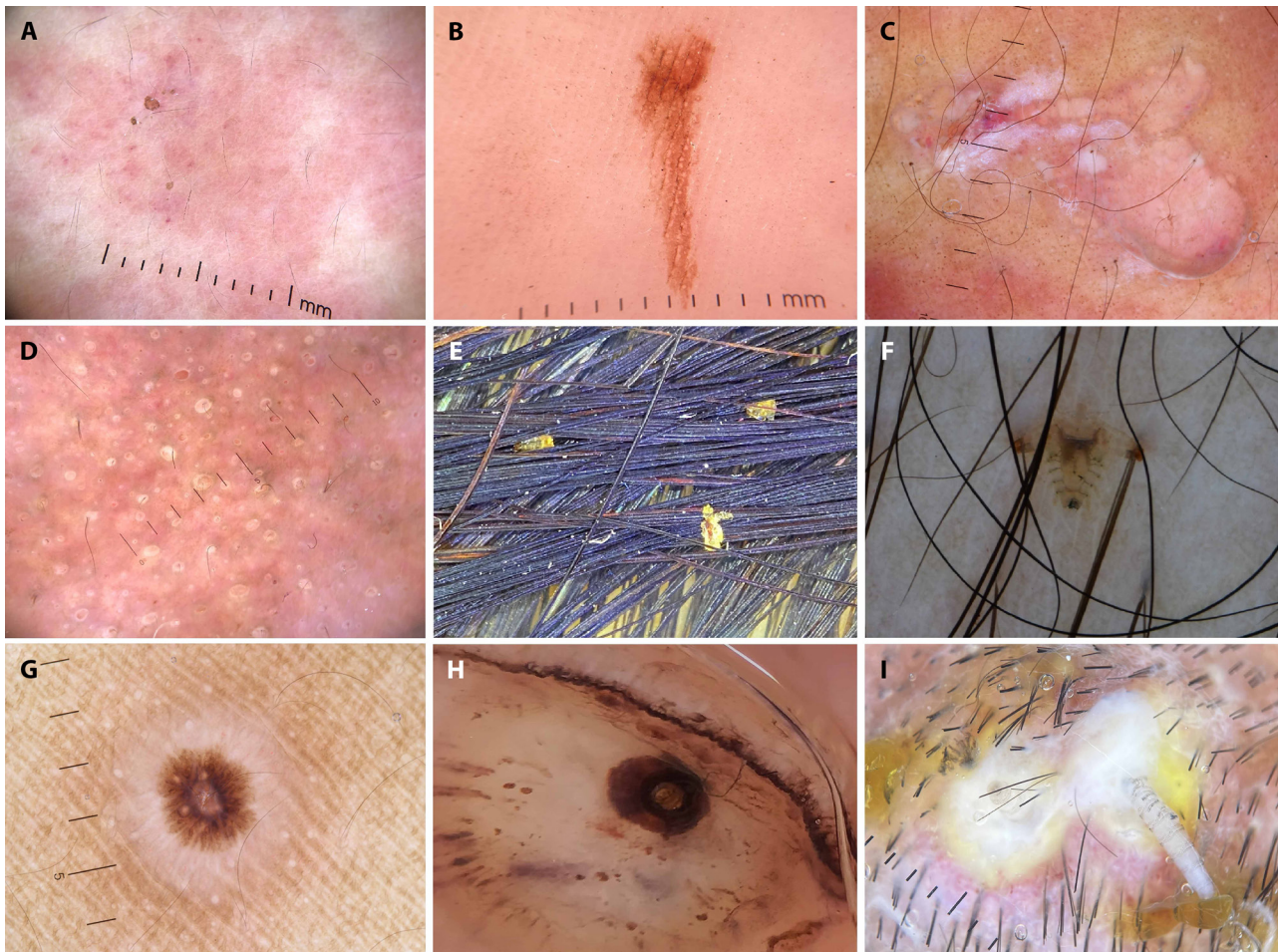


Figure 6. Examples of dermoscopic clues of skin bites/stings and parasitoses in dark-skinned patients: purple dots and crusting in bedbug bites (A); Brown structureless areas and lines (in the skin furrows) in cydnidae pigmentation (B); Well-defined, segmented brown/white linear structures in cutaneous larva migrans (C); Multiple follicular plugs in cutaneous leishmaniasis (D); Empty nits (translucent elongated structures with flat ending) and head lice in pediculosis capitis (E); Crab-shaped pubic lice with thick claws grasping hair shaft in pediculosis pubis (F); Central crusting with peripheral brown structureless area surrounded by a white halo in tick bite (G); Central pore with a faint pigmented peripheral ring and peripheral white structureless area containing blue globules in tungiasis (Courtesy of Elizabeth Leocadia Fernandes, MD – Mogi das Cruzes, Brazil) (H); Myiasis larva (I).

Warts

Six studies (one case-control study, four case-series and one single report) assessed dermoscopic patterns of warts (including common, palmoplantar, plane and genital subtypes) [9,30-34]. In detail, the main findings of common warts included brown dots, dotted vessels and black dots/globules (thrombosed vessels) over a white background. Palmoplantar warts showed a similar pattern, though they were also commonly reported to display papillary projections, interruption of skin markings, and perivascular white halos besides the aforementioned findings. With regard to plane warts, brown background was a constantly reported feature, while dotted vessels were described in a minority of cases. Finally, dotted vessels were the most commonly described findings in genital warts, followed by linear vessels and bluish background.

Fungal Infections

Chromomycosis

Dermoscopy of chromomycosis has been described in four single reports, with brown/black dots and yellow-orange structureless areas, and white scales/crusts being constantly reported [35-38]. Additionally, white reticular lines [35-38] and polymorphic vessels [36,38] were also observed in half of published instances.

Mycetoma

Three single reports describing dermoscopic pattern of mycetoma are available in the literature [39-41]. The most typical feature reported was the presence of white-yellow/yellow globules/structureless areas and grains (globules corresponding to microbial masses), whose color varied based on the subtype (red/white in actinomycetoma and black in eumycetoma) [39-41].

Pityriasis Versicolor

Pityriasis versicolor (PV) is the most studied fungal dermatosis from a dermoscopic point of view, with a case-control study, two case-series and two case-report for a total of 184 patients [9,42-45]. The main finding of both hypo- and hyper-pigmented variants was the presence of white scales in the skin furrows (over a dull diffuse white or brown background, respectively); notably, such a pattern of scaling was reported to be specific of PV when compared to other pigmentary disorders in the study by Errichetti *et al* [9]. Similarly, although less frequent, the detection of perifollicular white scaling was found to be peculiar of PV over the other analyzed conditions. Further characteristic findings described by Kaur *et al* included the so-called “contrast halo sign” (ring of alternate pigmentation surrounding the primary lesion) and folliculocentricity [43]. The latter feature (reported as perifollicular white halo) was found to be specific in the comparative analysis by Errichetti *et al* in achromic PV [9].

Pityrosporum Folliculitis

Two case-series involving a total of 60 cases have analyzed dermoscopy of pityrosporum (*Malassezia*) folliculitis (PF), with folliculocentricity and perilesional erythema reported to be constant findings [46-47]. Additional common (>75% of the analyzed instances) findings included (dotted, linear or linear-curved) in and around lesions and diffuse/peripheral white scales [46,47].

Rhinofacial Entomophthoromycosis

A single dermoscopic report on rhinofacial entomophthoromycosis does exist, with focal yellow-orange structureless areas and dotted/linear vessels being reported as the main features [48]. Additional findings included white structureless areas, scaling, and follicular plugs [48].

Sporotrichosis

Dermoscopy of sporotrichosis has mainly been described in a case-series on four patients (including cutaneous and lymphocutaneous subtypes) by Vinay *et al*, that reported yellow-orange areas and hemorrhagic crusting as constant findings [49]. Of note, the presence of yellow areas was also described in another single case of disseminated cutaneous sporotrichosis [50]. Vinay *et al* also found dermoscopic variability based on lesions localization and duration, with facial involvement also featuring follicular plugs and early and healing lesions respectively showing yellow-orange structureless areas along with variable dilated vessels and white (fibrotic) structureless areas with linear vessels [50].

Tinea Infections

Information on dermoscopic patterns of tinea manuum/pedis, tinea corporis (TC) and tinea incognito is available. Regarding tinea manuum/pedis, most knowledge comes from

the case-series by Bhat *et al* on ten instances that found white scales along creases to be a constant clue [51], in line with another single report [52].

Moving to TC, in their case-series involving 30 patients, Bhat *et al* found white scales (not specified arrangement) to be the most frequent finding (all cases), followed by scaly broken hair (half of the cases) [51]. Whereas, in a case-control study by Errichetti *et al* including 13 instances, peripheral white scales showing a jagged outer free edge turned out to be specific for TC when compared to other papulosquamous dermatoses [9]. Additionally, although less frequent, also peripheral yellow and brown scales were peculiar of TC.

With regard to *tinea incognito*, in the first report on a single instance, Sonthalia *et al* reported follicular findings to be the main clues, including perifollicular scales, black dots, and hair-shaft changes (i.e., broken/bent deformable hairs, “morse code” hairs, and transparent hairs) [53]. These dermoscopic features were subsequently validated by two case-series on a total of 52 patients [51,54].

White Piedra

Dermoscopy of white piedra has been investigated in a single report, that showed creamy yellow nodules distributed along the hair at irregular intervals [55], differently from trichobacteriosis axillaris that tends to feature yellow concretions along the entire length of the hair shaft [55].

Skin Parasitoses and Insect Bites/Stings

Bed Bug Bites

A single report describing dermoscopy of bed bug bites has been retrieved, with evidence of a central hemorrhagic punctum surrounded by erythema [56]. The authors also performed *ex vivo* dermoscopic examination showing multiple bed bugs and their empty eggs (appearing white and translucent) [56].

Cydnidae Pigmentation

Four single reports described dermoscopic features of cydnidae pigmentation [57-60]. The main feature consisted of brown dots/globules and/or lines [57,59,60]. Additionally, Jindal *et al* observed the presence of orange-brown structureless areas with ridge enhancement over the sole, thereby suggesting that the pigment released by the bug seeps through the skin dermatoglyphics [58].

Cutaneous Larva Migrans

Only a single report describing dermoscopic pattern of cutaneous larva migrans is available in the literature [61]. The authors observed well-defined segmented yellowish-white lines (corresponding to larval body), along with brown dots and peripheral white scales (representing empty larval tract) in the central part and multiple yellowish lines (reflecting pustules over the larval tract secondary to inflammation) in the distal half of the lesion [61].

Cutaneous Leishmaniasis

Most evidence on dermoscopy of cutaneous leishmaniasis (CL) comes from the case-control study by Errichetti *et al* including 14 instances that found follicular plugs, white lines (mainly peripheral-radiating), and ulceration (especially central) to be specific clues over other granulomatous dermatoses [9]. Such findings were also observed in two reports involving a total of 3 cases [62,63].

Gamasidosis

In a single report on gamasidosis (avian mite dermatitis), Toukabri *et al* utilized dermoscopy to identify the mite, which appeared red to black colored and replete with blood [64].

Pediculosis

Only four single reports have been retrieved (one each for pediculosis capitis, pediculosis pubis, pediculosis of facial hair, and phthiriasis palpebrarum) [65-68]. Badri *et al* found dermoscopy to be helpful in differentiating *pediculosis capitis* from scalp seborrheic dermatitis by showing grey, translucent, ovoid eggs, adherent firmly to the hair shafts (corresponding to nits) [65]. Dermoscopy of pediculosis pubis, pediculosis of facial hair, and phthiriasis palpebrarum has been found to show nits (viable containing unhatched nymphs and empty translucent casings) as well as crab-shaped lice having broad bodies and thick claws [66-68].

Post-Kala-Azar Dermal Leishmaniasis

Three reports have investigated dermoscopy of post-kala-azar dermal leishmaniasis (PKDL) [69-71]. The first description by Jha *et al* reported erythema and follicular plugs [70]. The presence of the latter finding was confirmed by Swarnkar *et al*, who observed it in hypopigmented macules, papules and nodules.⁷¹ In line with another report, Swarnkar *et al* also found yellow-orange structureless areas, thought to correspond to dermal granulomas [69, 71].

Tick Bites

Only a single report on dermoscopy of tick bites is available from the literature. In this instance a pink-red area at the center of tick-induced lesion was reported [72].

Tungiasis

A single case report on dermoscopy of tungiasis does exist, with brown pigmented ring around a central pore with surrounding whitish area and faint pigmented peripheral ring being described [73].

Wound Myiasis

Only one instance describing dermoscopic findings of wound myiasis has been retrieved [74]. In their report, the authors observed caudal end of larvae (spiracles having two oval openings with incomplete peritreme and prominent slits) [74].

Conclusions

The present review analysis underlines that dermoscopic knowledge on infectious dermatoses mainly comes from single reports, with a limited number of larger studies showing a high level of evidence. Moreover, the reproducibility of reported findings may also be limited by the highly variable terminology used in the retrieved studies. Hence, even though infectiouscopy is a promising aid for dermatologist, as it may facilitate the detection of subclinical findings strictly related to specific histological and/or microbiological features, further studies designed according to a systematic and standardized approach are needed for better characterization.

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