



REVIEW

# Dermoscopy in Monitoring and Predicting Therapeutic Response in General Dermatology (Non-Tumoral Dermatoses): An Up-To-Date Overview

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## ABSTRACT

Besides the well-known use in supporting the non-invasive diagnosis of non-tumoral dermatoses (general dermatology), dermoscopy has been shown to be a promising tool also in predicting and monitoring therapeutic outcomes of such conditions, with the consequent improvement/optimization of their treatment. In the present paper, we sought to provide an up-to-date overview on the use of dermoscopy in highlighting response predictor factors and evaluating therapeutic results in the field of general dermatology according to the current literature data. Several dermatoses may somehow benefit from such applications, including inflammatory conditions (psoriasis, lichen planus, dermatitis, granulomatous conditions, erythro-telangiectatic rosacea, Zoon balanitis and vulvitis, cutaneous mastocytosis, morphea and extra-genital lichen sclerosus), pigmentary disorders (vitiligo and melasma) and infectious dermatoses (scabies, pediculosis, demodicosis and viral warts).

**Keywords:** Dermoscopy; Dermoscopy; Monitoroscopy; Outcomes; Treatment; Therapy

### Key Summary Points

#### Why carry out the study?

Dermoscopy has recently been shown to be a promising tool in predicting and monitoring therapeutic outcomes of non-tumoral dermatoses (general dermatology).

Data on such a novel application is, however, sparse and no detailed review paper on this topic exists.

#### What was learned from the study?

We provided an up-to-date overview on the use of dermoscopy in highlighting response predictor factors and evaluating therapeutic results in the field of general dermatology according to the current literature data.

Dermoscopy may be of aid in the improvement/optimization of the management of several non-tumoral dermatoses by highlighting possible clinically subtle/invisible response predictors (positive or negative) and monitoring the lesions' changes at a subclinical level.

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## DIGITAL FEATURES

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## INTRODUCTION

Over the last few decades, the dermoscope has become an invaluable tool in dermatological daily clinical practice thanks to its ability to show findings not visible to the naked eye, thereby often being referred to as the dermatologist's "stethoscope" [1, 2]. Although it is traditionally used in the assessment of both melanocytic and non-melanocytic proliferative lesions as well as hair disorders [1–3], dermoscopy is increasingly gaining appreciation in the spectrum of non-tumoral skin conditions (i.e. general dermatology), including inflammatory, pigmentary, infectious and infiltrative dermatoses, with consequent reduction in the number of cases requiring biopsy [3–12]. In this regard, such a technique has been shown to have further applications apart from assisting the clinical diagnosis, including predicting and monitoring therapeutic outcomes, with the consequent improvement/optimization of the management of non-tumoral dermatoses [3–7].

The aim of this paper is to provide an up-to-date overview on the use of dermoscopy in highlighting response predictor factors and evaluating treatment results in the field of general dermatology according to the current literature data.

An electronic search was performed in August 2020 by using the PubMed database. In the first step the search terms were "predictors" AND "dermoscopy" (OR "dermatoscopy" OR "videodermoscopy"); "predictor factors" AND "dermoscopy" (OR "dermatoscopy" OR "videodermoscopy"); "monitoring" AND "dermoscopy" (OR "dermatoscopy" OR "videodermoscopy"); "follow-up" AND "dermoscopy" (OR "dermatoscopy" OR

"videodermoscopy"). In the second step the search protocol included specific diagnoses i.e. "psoriasis" AND "dermoscopy" (OR "dermatoscopy" OR "videodermoscopy"). Additionally, pertinent references not identified by search engine and retrieved from articles/books were also taken into account. All studies written in English dealing with treatment outcomes prediction and monitoring of non-tumoral diseases (including inflammatory, pigmentary, infiltrative and infectious dermatoses) were analysed, including controlled studies, case series, case reports and reviews. Articles addressing hair, nail and mucosal diseases were excluded.

Tables 1 and 2 summarise dermoscopic data on response predictor factors and clues in treatment follow-up of non-tumoral dermatoses, including inflammatory, pigmentary and infectious diseases. This article is based on previously conducted studies and does not contain any studies with human participants or animals performed by the author.

### Inflammatory Diseases

#### *Psoriasis*

Psoriasis is surely the most studied inflammatory condition from a dermoscopic point of view [13]. Its hallmarks on dermoscopy include uniform dotted/globular vessels and diffuse white scales; however, haemorrhagic dots/globules are also commonly seen and are often related to scratching [3–7], being found more frequently in areas in which psoriasis is typically itchy, such as scalp and legs [14]. Notably, at higher magnification (videodermoscopy), psoriatic dilated vessels usually show a bushy appearance [3–6].

Several studies have demonstrated that videodermoscopic follow-up of psoriasis may facilitate treatment response assessment by showing changes in vessels morphology and diameter [15–23]. In particular, studies evaluating under high magnification (from  $\times 100$  to  $\times 300$ ) psoriatic plaques successfully treated with either topical [15–18] or systemic [19–23] therapies revealed a progressive reduction of vessels' tortuosity and diameter over the time

**Table 1** Dermoscopic data on response predictor factors and clues in treatment follow-up of inflammatory diseases

Disease	Main dermoscopic diagnostic clues	Dermoscopic response predictors	Clues in treatment follow-up	Type of supporting evidence
Psoriasis	Uniform dotted/globular vessels	Haemorrhagic dots appearing in the first 2/4 weeks of treatment with biologics are associated with a good outcome	Reduction of vessels' diameter and tortuosity at high magnification (videodermoscopy) during effective (topical or systemic) therapies	Case series [15–26]
	Diffuse white scales	Baseline globular and dotted vessels are respectively associated with bad and good response to both narrowband ultraviolet B phototherapy and topical calcipotriol/betamethasone therapy Persistence of vessels at the end of topical calcipotriol/betamethasone therapy is related to an earlier relapse	Early (subclinical) detection of disease recurrence (appearance of dotted vessels) Early (subclinical) detection of steroid-induced skin atrophy (appearance of linear/reticular vessels)	Review/book (mechanism-based reasoning) [3]
Lichen planus	Wickham striae	–	Monitoring stage evolution of lesions under treatment Likelihood of post-inflammatory pigmentation persistence (dots and diffuse pigmentation are related to a longer and shorter course, respectively)	Review/book (mechanism-based reasoning) [3–8] Case reports [27]
Dermatitis	Clustered dotted vessels	–	Reduction of crusts and scales along with vascular pattern normalization during dupilumab treatment	Case series [28]
	Diffuse white scales		Early (subclinical) detection of steroid-induced skin atrophy (appearance of linear/reticular vessels)	
Granulomatous dermatoses	Orange structureless areas	Indirect prediction of therapeutic outcomes in granuloma annulare by facilitating the recognition of the histological subtype	Disappearance of vessels and orange areas during effective therapies	Review/book (mechanism-based reasoning) [29] Case series [30]
Rosacea (erythro-relangiectatic)	Linear vessels arranged in polygonal networks (vascular polygons)	Baseline protruding follicular plugs are associated with a better response to topical ivermectin therapy	Reduction of vessels as a marker of laser therapy efficacy	Case series (personal observation)
Zoon balanitis and vulvitis	Orange areas Focused curved vessels	–	Normalization of dermoscopic vascular pattern as a marker of therapeutic efficacy	Case report [37]
Cutaneous mastocytosis	Coarse brown network (urticaria pigmentosa)	*Reticular* vascular pattern (along with serum tryptase levels and plaque-type lesions) is associated with the need for a maintained antimediation therapy	Monitoring stage evolution of lesions (mastocytoma)	Case series [38] Review/book (mechanism-based reasoning) [39]
	Yellow-orange areas (mastocytoma) Diffuse light-brown discoloration and/or brown network (mastocytoma)			
Morphea	Ill-defined dull white globules	–	Higher accuracy in monitoring inflammation and fibrosis regression by showing vessels and white areas reduction, respectively	Case-controlled study [41]

**Table 1** continued

Disease	Main dermoscopic diagnostic clues	Dermoscopic response predictors	Clues in treatment follow-up	Type of supporting evidence
Lichen sclerosus (extra-genital)	Bright white areas Follicular plugs	–	Higher accuracy in monitoring inflammation and fibrosis regression by showing vessels and white areas reduction, respectively	Case-controlled study [41]

**Table 2** Dermoscopic data on response predictor factors and clues in treatment follow-up of pigmentary and infectious diseases

Disease	Main dermoscopic diagnostic clues	Dermoscopic response predictors	Clues in treatment follow-up	Type of supporting evidence
Vitiligo	Milky/bright white structureless areas with sharp and convex margins White hairs (leukotrichia) Perifollicular pigmentation	Baseline white hairs are related to poor response in both non-segmental vitiligo treated with excimer laser and segmental vitiligo treated with phototherapy, laser or surgery Baseline perifollicular pigmentation is associated with a good outcome in non-segmental vitiligo treated with narrowband ultraviolet B phototherapy Selection of the most appropriate therapy according to the lesion stage (active vs stable)	Assessment of initial therapeutic response by showing subclinical pigmentation	Case series [42–48]
Melasma	Light/dark brown, grey or blue pseudonetwork	Prediction of therapeutic response by facilitating the recognition of lesions deepness Significant dermoscopic vascular component supports the use of pulsed-dye laser	Assessment of initial therapeutic response by showing attenuation/regression of pigmentary and vascular structures	Case series [49–54]
Scabies	“Delta-wing jet with contrail” sign	–	Absence of mite migration 24 h after an effective treatment Progressive degradation of the mite with replacement with an amorphous material after an effective treatment	Case series [55, 56]
Pediculosis	Evidence of louse and nits	–	Disappearance of parasites and viable nits after an appropriate therapy	Case series [57] Case series [58]
Demodicosis	Protruding follicular plugs	–	Reduction of protruding follicular plugs as a marker of therapy efficacy	Case report [59]
Warts	Dermatoglyphic/skin furrows interruption Thrombosed capillaries (common warts) Dotted vessels with white halos (plane warts)	–	Assessment of complete healing by showing disappearance of subclinical findings	Review/book (mechanism-based reasoning) [60]

up to a complete normalization (i.e. capillaries with diameters  $\leq 25 \mu\text{m}$  [23]), although this may sometimes not be reached despite clinical healing [23]. The possibility to evaluate vascular

changes in psoriasis has a double practical implication: (I) early assessment of treatment response, as reduction in vessels' diameter and tortuosity may already be seen in the first weeks



**Fig. 1** Clinical picture of a psoriatic plaque on the right leg (white square) at baseline (a), with corresponding dermoscopy image showing presence of uniform globular vessels (better visible in inset) and diffuse white scaling (b). Clinical view of the same lesion after 4 weeks of therapy with calcipotriene plus betamethasone dipropionate

aerosol foam showing limited improvement (Local Psoriasis Severity Index improvement < 50%) (c). (From Errichetti E, et al. *Dermatol Ther (Heidelb)* 2020;10:757–67)

of therapy [15–23], and (II) evaluation of persistence of vascular abnormalities in clinically healed lesions, as their presence has been supposed to be related to a higher tendency to relapse [22].

Interestingly, recent studies showed that even hand-held dermoscopy ( $\times 10$  magnification) may be of aid in treatment outcomes assessment in plaque-type psoriasis [24–26]. Specifically, the appearance of haemorrhagic dots in the first 2/4 weeks of treatment is a predictor of subsequent response to biological agents [24], while the baseline evidence of globular and dotted vessels has respectively been related to a negative and positive response to both narrowband ultraviolet B phototherapy [25] and calcipotriene/betamethasone aerosol foam (Fig. 1) [26]. Additionally, regarding this last therapy, relapse is strongly associated with the persistence of vascular structures (either dotted or globular vessels) on dermoscopy at the end of the therapy when considering both lesions regardless of degree of improvement and lesions reaching a complete/nearly complete clinical healing [26]. Accordingly, it has been suggested that a “dermoscopic healing” would be more advisable than a mere “clinical healing” in order to ensure a longer response retention in psoriasis treated with calcipotriene/betamethasone aerosol foam [26].

Finally, hand-held dermoscopy is also helpful in early detection of both disease recurrence



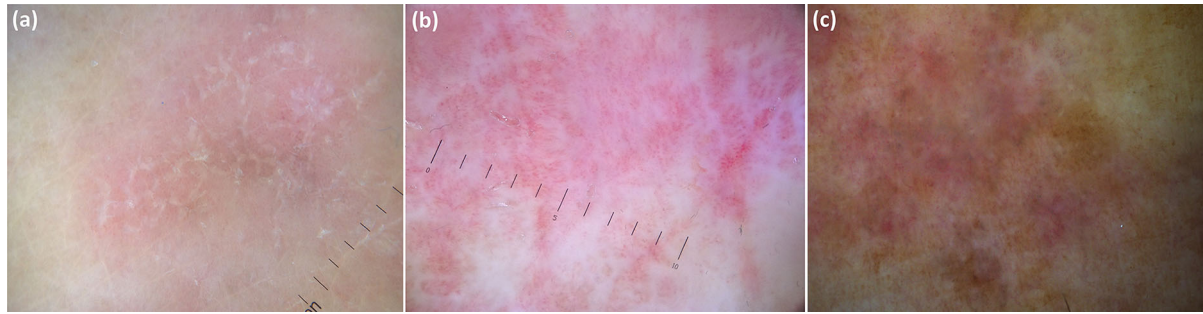
**Fig. 2** Dermoscopy of a psoriatic plaque after prolonged use of topical steroid reveals linear vessels (arrow) suggesting that skin atrophy has initiated, though it is not visible yet on clinical examination

(as dermoscopic changes occur prior to clinical worsening) [24] and steroid-induced skin atrophy (by showing linear/reticular vessels before telangiectasias become clinically apparent) (Fig. 2) [3].

### **Lichen Planus**

The presence of Wickham striae on dermoscopy is a pathognomonic sign of lichen planus [3–8]. They usually appear as intersecting crossing white lines forming a sort of network, yet other morphologies (e.g. linear, radial, annular and round) and colours (i.e. yellow and blue-white)





**Fig. 3** Dermoscopic pattern of lichen planus varies according to disease stage: subtle Wickham striae over a reddish background are seen in early stages (a), while mature and long-standing lesions respectively display well-

represented Wickham striae along with peripheral dotted/linear vessels (b) and pigmented structures with Wickham striae and vascular remnants (c)

are also seen less commonly [3–8]. Additional findings include (I) dotted, globular and/or linear vessels, mainly detectable at the periphery of the lesion; (II) white/yellow dots; and (III) pigmented structures (dots, globules and/or reticular or cloud-like areas) [3–8].

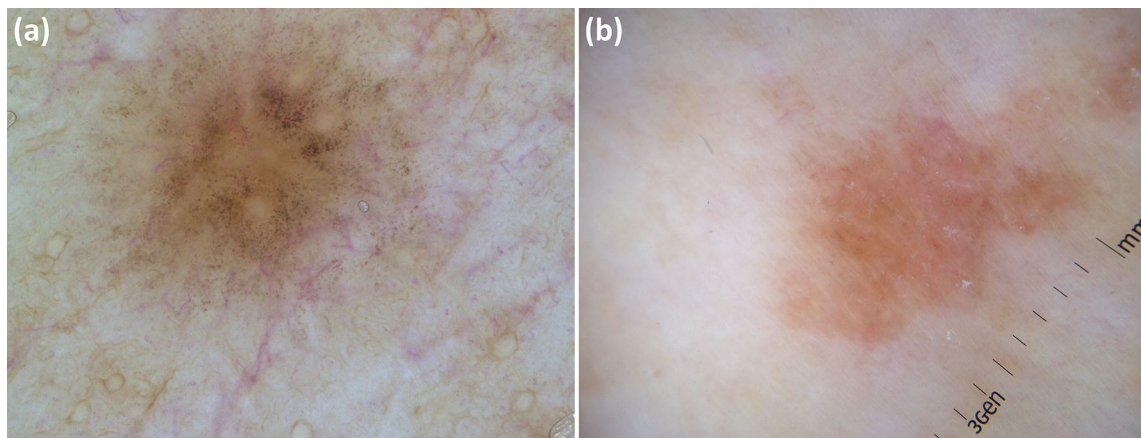
Although all the aforementioned findings may sometimes coexist in a single lesion, dermoscopic patterns of lichen planus usually vary according to disease stage (Fig. 3), with early papules usually showing subtle Wickham striae over a reddish background and mature lesions displaying well-represented Wickham striae and peripheral vessels [3–8]. Both of these structures tend to fade over time, concomitantly to the gradual appearance of pigmented structures, and in long-standing lesions, pigmentary

findings are often the only visible clue [3–8]. Accordingly, dermoscopy may be useful to accurately monitor disease stage evolution of lesions under treatment [8].

Additionally, dermoscopic examination may also be used to assess the likelihood of post-inflammatory pigmentation persistence, with homogeneous, structureless and light brown areas devoid of granularity being correlated with a shorter duration and granular pigmentation being associated with a longer course (Fig. 4) [27].

#### **Dermatitis**

The dermoscopic pattern of dermatitis varies according to the disease stage, even though overlaps are possible [3–8]. In particular, yellow



**Fig. 4** Post-inflammatory pigmentation in lichen planus may feature two dermoscopic patterns, i.e. granular pigmentation (a) and homogeneous brown area (b), respectively associated with a longer and shorter persistence

serocrusts and dotted vessels distributed in clusters or randomly are typically seen in acute/subacute phases, while more or less uniform dotted vessels surrounded by a white halo are the main dermoscopic features in chronic phases (lichenification) [3–8]. Haemorrhages are also seen quite commonly as a result of intense itching [3–8].

A recent study demonstrated that atopic dermatitis treated with a 16-week course of dupilumab displayed a remarkable reduction of crusts and scales along with vascular pattern normalization on dermoscopic examination compared to baseline, thereby making dermoscopy a useful tool to assess subclinical improvement in this condition [28]. Notably, such dermoscopic changes seemed to occur concomitantly with objective [EASI (Eczema Area and Severity Index) score] and subjective [P-NRS (Peak Pruritus Numerical Rating Scale) and DLQI (Dermatology Life Quality Index) scores] clinical improvement [28].

Moreover, as a result of the common use of topical steroids in dermatitis, dermoscopy plays a significant role in preventing steroid-induced skin atrophy by showing subclinical early signs, i.e. linear and/or reticular vessels [3].

### **Granulomatous Dermatoses**

The dermoscopic hallmark of granulomatous skin diseases is the presence of focal or diffuse orange structureless areas histologically corresponding to compact dermal granulomas, although such structures may be sometimes absent (i.e. deeply located granulomas or presence of remarkable epidermal changes) and are also seen in other conditions characterized by dense cell infiltrates or haemosiderin deposits in the dermis [29]. Additional dermoscopic clues may also be found in each granulomatous dermatosis (i.e. focused vessels in sarcoidosis and lupus vulgaris, follicular plugs and peripheral white striae in leishmaniasis, blurred vessels in granuloma annulare, yellow areas and serpiginous-branching vessels in necrobiosis lipoidica and vascular polygons in granulomatous rosacea) [29].

In general, dermoscopic examination may be of aid in treatment monitoring of granulomatous skin conditions by showing disappearance

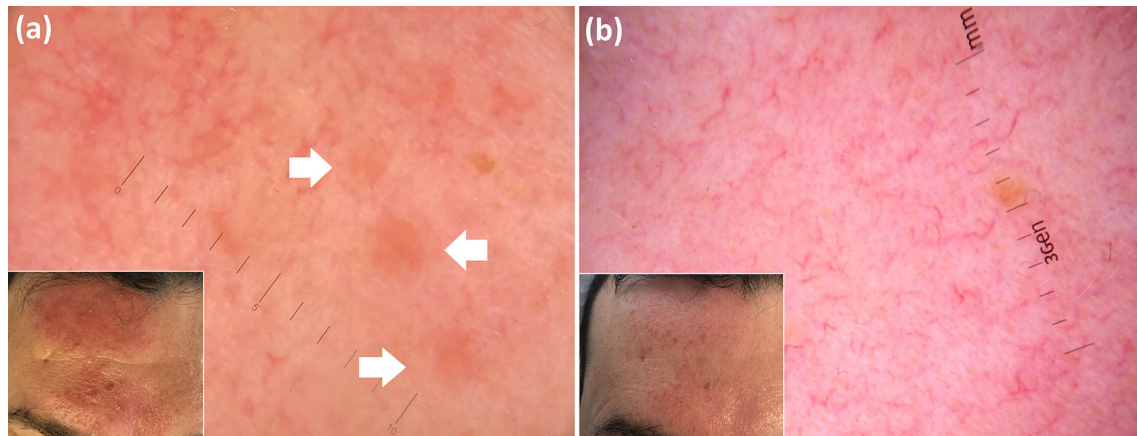
of vascular and non-vascular findings, especially orange areas as they are a marker for the presence of compact granulomatous infiltrate in the dermis (Fig. 5) [29, 30]. However, a recent study emphasized that such dermoscopic structures may persist despite treatment in sarcoidosis, likely because of an incomplete efficacy of therapies with persistence of some degree of subclinical inflammation [30].

Finally, dermoscopy may indirectly help predict therapeutic outcomes in granuloma annulare by facilitating the recognition of the histological subtype, i.e. palisading vs interstitial, respectively characterized by an orange and pinkish background (Fig. 6) [31]. Indeed, it has been reported that the pathological pattern might influence the disease course/therapeutic response, with the palisading granuloma subtype being associated with a more protracted course/significant resistance to treatments than the interstitial form [31].

### **Erythro-Telangiectatic Rosacea**

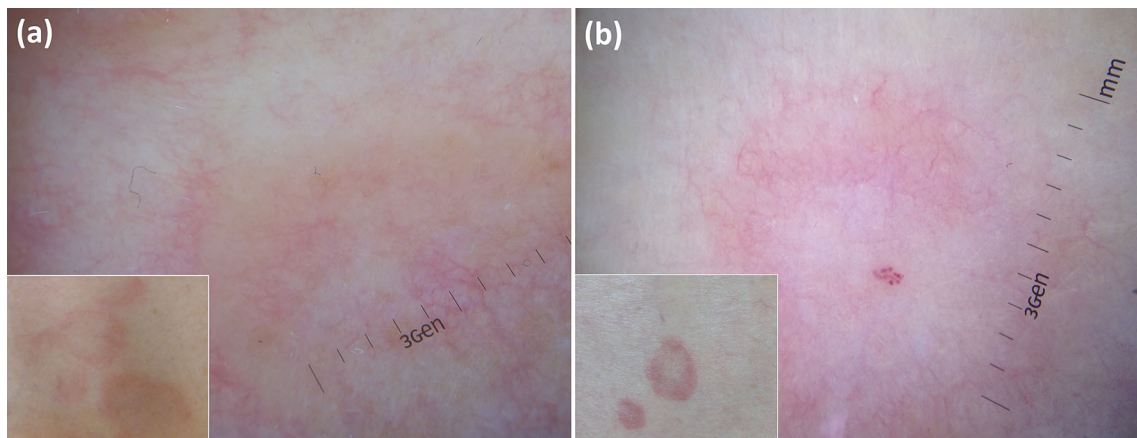
Recognizing this facial dermatosis on dermoscopy is a very straightforward task owing to the presence of a highly specific feature, namely linear vessels characteristically arranged in polygonal networks (vascular polygons) [3–7]. Additional, less specific findings include rosettes, follicular plugs, white-yellowish scales, pigmentation structures and dilated follicle [3–7].

Besides diagnostic purposes, dermoscopic assessment in erythro-telangiectatic rosacea may also be helpful in monitoring post-treatment changes (with reduction of vascular and non-vascular findings, especially when treated with lasers) and predicting therapeutic response to topical treatments [32]. Indeed, according to a preliminary analysis on 20 patients suffering from erythro-telangiectatic rosacea, the presence of protruding follicular plugs is associated with a better response to an 8-week course of ivermectin 10 mg/g cream compared to metronidazole 1% gel used for the same time span (personal observations) (Fig. 7). This would be due to the possible active effect of the former therapy on *Demodex folliculorum* as there is a correlation between protruding follicular plugs on dermoscopy and a higher mite density that



**Fig. 5** Dermoscopic assessment (**a** baseline; **b** after 8 weeks of oral doxycycline therapy) in a case of granulomatous rosacea of the forehead allows one to see the

disappearance of orange areas (*a* arrows), histologically related to dermal granulomatous infiltrate fading



**Fig. 6** Granuloma annulare shows a different dermoscopic background according to histological subtype, i.e. orangish in “palisading” variant (**a**) and pinkish in “interstitial” variant (**b**), so dermoscopy may help in predicting

therapeutic outcomes as the pathological pattern might influence the disease course/therapeutic response

may be seen in rosacea (typically less than 5 mites/cm<sup>2</sup>) [33].

### **Zoon Balanitis and Vulvitis**

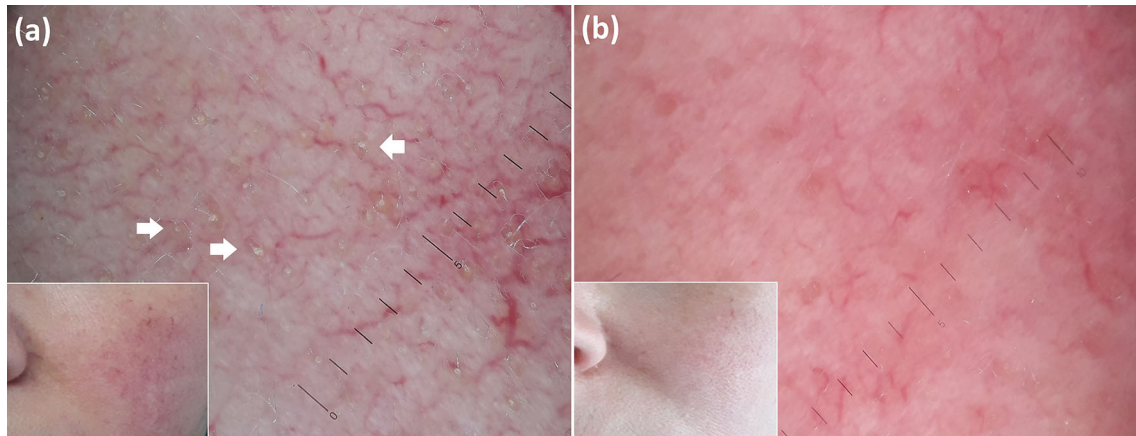
Such conditions are dermoscopically characterized by orange structureless areas and linear-curved vessels (including serpentine, chalice-shaped or convoluted) [34–37]. It has been reported that normalization of the dermoscopic vascular pattern may indicate resolution of the active phase despite the persistence of orange areas on both dermoscopy and clinical

assessment (which may be evident for a long time) (Fig. 8), thus avoiding overtreatment of patients and its possible consequences (e.g. steroid-induced skin atrophy) [37].

### **Cutaneous Mastocytosis**

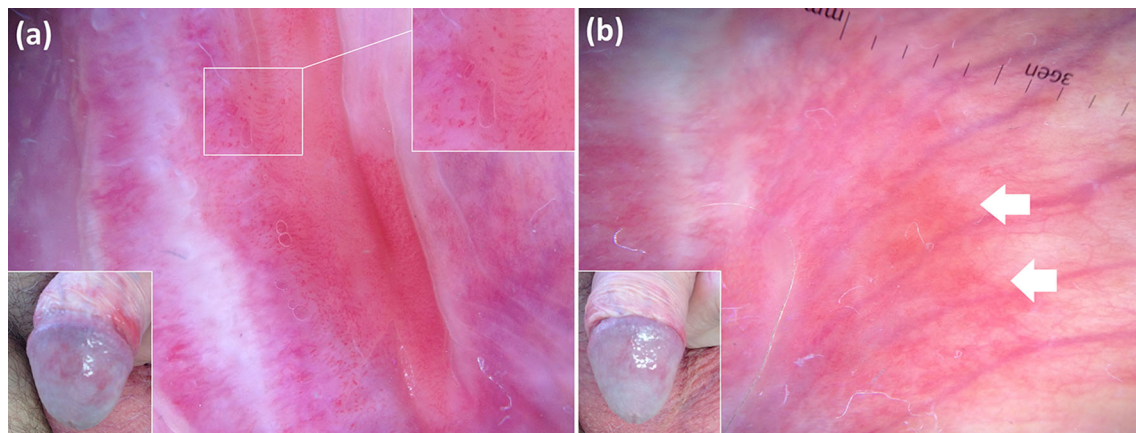
Apart from facilitating diagnosis (by showing coarse brown network or homogeneous brown areas), dermoscopy may also be of aid in therapeutic management of urticaria pigmentosa [38]. Indeed, although visible in a minority of cases, the presence of a “reticular” vascular





**Fig. 7** Erythro-telangiectatic rosacea. Besides typical vascular polygons, this patient also shows protruding follicular plugs (arrows) on baseline dermoscopic examination (a); an optimal clinical response is reached after an 8-week

topical course of ivermectin, with disappearance of protruding plugs on dermoscopy (b)

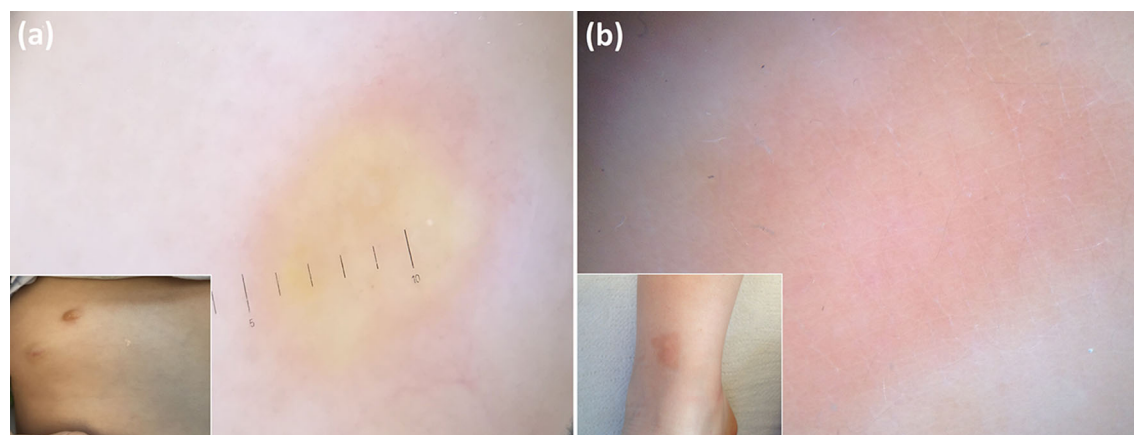


**Fig. 8** Zoon balanitis. Baseline dermoscopic assessment (a) reveals linear-curved vessels (better visible in the upper right inset). Dermoscopy after a 4-week course of a topical steroid (b) shows improvement of inflammation by displaying disappearance of the aforementioned vessels,

though orange areas (arrows) are now evident (however, they are not a typical sign of disease activity as they correspond to dermal haemosiderin deposits on histology)

pattern on dermoscopic assessment, along with serum tryptase levels and plaque-type lesions, was found to represent the best combination to predict the need for maintained antimediator therapy in one study [38]. Consequently, the authors hypothesized that, in combination with other variables, dermoscopy could provide additional help in the identification of patients at risk for more severe symptoms [38].

Additionally, dermoscopic examination may also be used in the follow-up of mastocytoma as lesions in regressing/healing phases usually do not display yellow-orange areas (which are more common in mature lesions) but only a diffuse light-brown discoloration and/or brown network (Fig. 9) [39].



**Fig. 9** Dermoscopy of a mature/well-developed mastocytoma reveals yellowish areas (a), while a diffuse light-brown discoloration is seen in a healing lesion (b)

### ***Morphea and Extra-Genital Lichen Sclerosus***

Dermoscopy has been speculated to be a possible effective technique for treatment monitoring of such conditions since it allows a more accurate assessment of inflammation regression and fibrotic process compared to clinical examination only [40, 41]. Indeed, dermoscopy shows a better correlation with pathologic findings, with erythema/vessels and white areas (ill-defined dull white globules in morphea and bright white areas in extra-genital lichen sclerosis) strictly related to dermal inflammation and sclerosis, respectively [41]. Consequently, it is possible to optimize the duration of therapy according to the persistence/resolution of sub-clinical inflammatory signs despite an “apparent” clinical healing, thus preventing fibrosis progression [41].

### **Pigmentary Dermatoses**

#### ***Vitiligo***

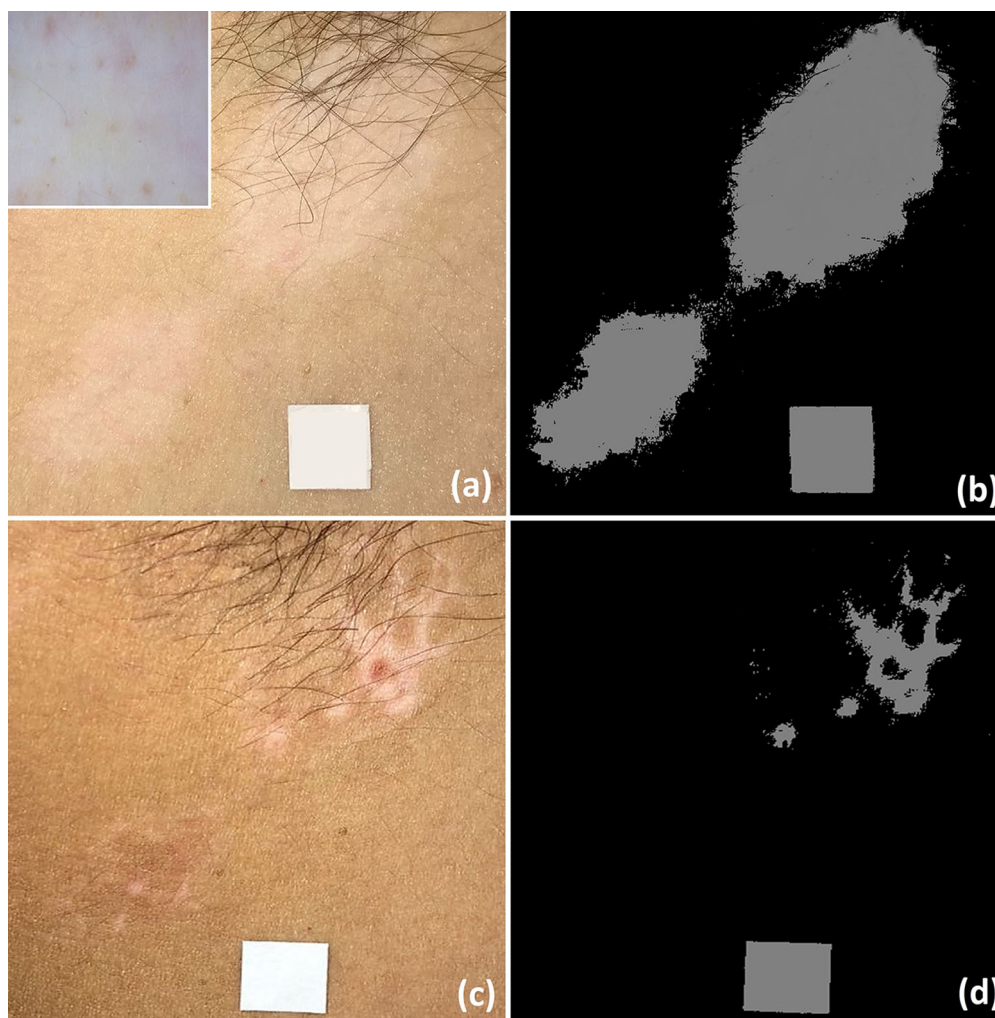
Milky/bright white structureless areas with sharp and convex margins represent the most common dermoscopic pattern of vitiligo [42, 43]; other possible findings include white hairs (leukotrichia), perifollicular pigmentation (more common in early and repigmenting lesions), perifollicular depigmentation, marginal pigmentation, marginal reticular pigmentation, reversed pigmentary network, and intralesional pigmentary (structureless or

network-like) patches, with the last two features being more common in early stages of disease [42, 43].

Of note, margins may sometimes also be irregular and/or less defined giving rise to specific patterns (i.e. trichrome, “starburst” and “comet tail”), which have been related to disease activity [42, 43]. Additional signs of active/progressive lesions include the presence of small white globules in perilesional skin (described as satellites, confetti-like pattern and “tapioca sago” appearance) and micro-Koebner’s phenomenon (i.e. occurrence of isomorphic depigmented streaks along the line of trauma around the main vitiligo patch) [42, 43]. On the other hand, sharp borders and perilesional hyperpigmentation are considered signs of disease stability [42, 43]. From a management point of view, it is important to know if a vitiligo lesion is in a stable or active phase as some therapies are strictly related to disease stage (e.g. surgical treatments are preferentially done when disease is stable) [42, 43].

Additionally, dermoscopy has been reported to be a reliable tool to assess initial therapeutic response to treatments as it may show increases in perilesional and intralesional pigmentation that are not visible to the naked eye [44, 45].

Finally, dermoscopic examination has also been shown to be useful to predict therapeutic outcomes [46–48]. In particular, a recent study showed a reduced response rate to excimer laser therapy of non-segmental vitiliginous lesions



**Fig. 10** Baseline clinical image of vitiligo involving right armpit (inset: dermoscopic examination shows presence of subclinical perifollicular pigmentation) (a); the same lesions seen by using a computer-aided method (b). Significant improvement at the end of the 30 sessions of narrowband ultraviolet B phototherapy is visible on

displaying white hairs on baseline dermoscopy [46]. That finding was confirmed in a study on patients suffering from segmental vitiligo treated with either medical (phototherapy or laser therapy) or surgical treatments [47], yet it was not seen in another study investigating patients with non-segmental vitiligo treated with ultraviolet B phototherapy, which only found a correlation between positive response and dermoscopic evidence of perifollicular pigmentation at baseline (Fig. 10) [48].

clinical examination (c) and by using a computer-aided method (d). (From Errichetti E, et al. *Dermatol Ther (Heidelb)* 2020. <https://doi.org/10.1007/s13555-020-00431-6>)

### **Melasma**

Dermoscopic features of melasma include light/dark brown, grey or blue pseudonetwork (pigmentation with follicular and appendages ostia sparing) and, less commonly, telangiectasias (which are usually less thick than steroid overuse-induced vessels) as well as pigmented annular or arcuate structures, dots and globules [49–54].

The role of dermoscopy in therapeutic management of melasma has been investigated by several studies including patients treated



with either topical treatments (tranexamic acid, hydroquinone, and combinations of hydroquinone, glycolic acid and hyaluronic acid) or laser therapies [49–54]. Besides the use of this technique in following up lesions changes during the treatment to see the attenuation/regression of pigmentary and vascular structures, dermoscopic examination also has a role in predicting therapeutic response in melasma as it allow one to establish the deepness of the lesions, i.e. epidermal (dark to light brown colour and sharp edges), dermal (grey to blue colour with ill-defined margins with or without annular/arcuate pigmented structures) or mixed (combination of dermoscopic findings), with the last two variants being notoriously more resistant to therapies [49–54].

Additionally, dermoscopy is useful in choosing the type of treatment since the presence of a significant vascular component on dermoscopic assessment (“telangiectatic melasma”) would support the use of a laser therapy targeting vessels (e.g. pulsed-dye laser) [54].

## Infectious Dermatoses

### Scabies

Scabies is one of the skin diseases that benefit most from dermoscopy in terms of both diagnosis and treatment monitoring [55, 56]. Hand-held dermoscopic examination typically displays the pathognomonic “delta-wing jet with contrail” sign, which represents the irregular burrow excavated by the mite, whose anterior part of the body is visible as a small black arrowhead/triangular area at the end of the whitish wavy line (corresponding to the burrow) [3–7]. At higher magnification (videodermoscopy— $\times 20$  to  $\times 600$ ), epimeres (chitinous internal structures attached to legs), anterior outlines, eating tools and both pairs of forelegs and hind legs of *Sarcoptes scabiei* are visible [55, 56].

Post-treatment follow-up of scabies may allow one to see the absence of migration of mites (after 24 h) and their progressive degradation with a gradual disappearance of their outlines and replacement with an amorphous material [55]. These last morphological changes have been reported to occur after mite

immobilization, i.e. 48 h [55] to 2 weeks [56] after therapy administration. Notably, even hand-held dermoscopes ( $\times 10$  magnification) may show the disappearance of the “arrowhead/triangular area”, although the accuracy of low magnification is obviously lesser than videodermoscopic evaluation [57].

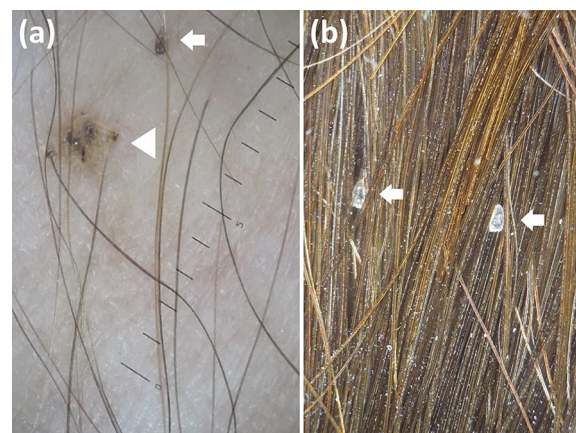
### Pediculosis

Dermoscopic examination of pediculosis may easily allow identification of parasites and eggs when these are not easy to identify by clinical inspection [57, 58]. Morphology of head and body lice is similar (though the latter is bigger) and consists of an elongated body, three pairs of clawed legs and narrow anterior mouthparts, while pubic lice differ from the presence of a short broad body [57, 58] (Fig. 11).

Additionally, besides demonstrating the absence of parasites after an appropriate therapy, dermoscopy may also help assess the presence of viable nits [57, 58]. Specifically, nits containing nymphs are ovoid brown structures, while empty nits are translucent and typically show a plane and fissured free ending [57, 58] (Fig. 11).

### Demodicosis

Under dermoscopy, demodicosis typically shows white-yellow follicular plugs which may



**Fig. 11** Dermoscopy of a case of pediculosis pubis shows a louse (arrowhead) as well as a viable nit having a brown colour and oval shape (arrow) (a); empty nits (arrows) in a patient successfully treated for pediculosis capitis are seen as translucent structures showing a plane free ending (b)



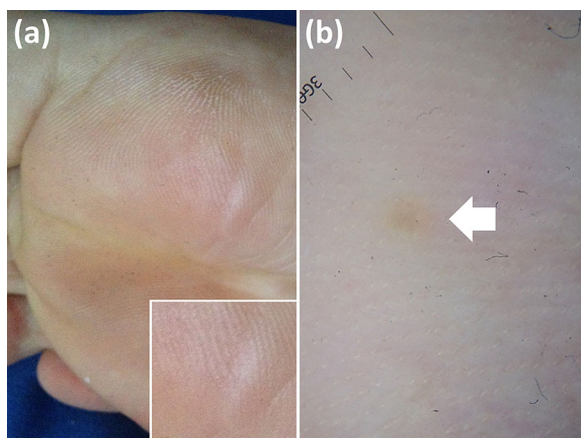
or not protrude from the skin surface (known as “*Demodex* tails” and “*Demodex* follicular openings”, respectively) [3–5]. Other unspecific dermoscopic findings may be observed, including diffuse erythema, scaling, pustules and reticular dilated vessels [3–5].

It has been speculated that dermoscopy may have a role in monitoring and optimizing treatment of this condition by showing the reduction of subclinical follicular plugs as they would be strictly related to the presence of a mixture of keratotic material and mites in the follicles [59].

### Warts

Common and plantar warts are classically typified by dermatoglyphic/skin furrows interruption, dotted and/or linear vessels having white halos, finger-like projections containing elongated vessels surrounded by a white halo and thrombosed capillaries (seen as purple-black dots/lines), while plane warts usually feature dermatoglyphic/skin furrows interruption along with dotted vessels over a white background [5–7].

The main application of dermoscopy in therapeutic management of such lesions is represented by the assessment of a complete healing as it allows one to see subclinical persistence of infection (Fig. 12) that may be



**Fig. 12** Plantar wart. Despite clinical examination indicating healing (a), dermoscopic examination still displays lesion remnant by revealing dermatoglyphics interruption (arrow) (b)

responsible for its spreading if not further treated [60].

## CONCLUSIONS

Dermoscopy may benefit therapeutic management of several non-tumoral skin conditions by highlighting possible clinically subtle/invisible response predictor factors (positive or negative) and monitoring the lesions changes at a subclinical level. The first possibility may help in choosing the most appropriate therapy and avoid unnecessary treatments, while the second advantage may allow one to appreciate early signs of response/recurrence (before clinical changes become evident) as well as ensure the disappearance of subclinical findings that may be related to inflammation/infection persistence, thus preventing disease spreading/recurrence.

Importantly, available supporting evidence has sometimes been drawn by using specific treatments or according to single case reports/mechanism-based reasoning. Therefore, future studies including dermoscopic-pathological correlation of subclinical changes during and after therapies are needed to support the existing promising data.

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