Dermoscopy: A Literature Review

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Abstract

Dermoscopy is a surface skin microscopy technique that rapidly grew during the past years enhancing the non invasive dermatological diagnostic techniques effectively. Its main applications include classic dermoscopy, trichoscopy, entomodermoscopy, inflammoscopy, capillaroscopy and dermoscopy for treatment decision and monitoring.

Introduction

Dermoscopy is a non-invasive technique that allows a rapid and magnified in vivo observation of the skin with the visualization of morphologic features invisible to the naked eye [1]

Benefits[2]

1. Helps to differentiate melanocytic from non-melanocytic skin lesions.
2. Helps to differentiate benign from malignant skin lesions.
3. Increases the diagnosis of early melanoma.
4. Increases the diagnosis of melanoma incognito.
5. Helps to avoid unnecessary surgery.
6. Helps to plan surgery.
7. Helps one to work better with their pathologist (asymmetrical high risk criteria, collision tumors, dermoscopic-pathologic correlation).
8. Patient reassurance.
9. Allows for follow up of patients with multiple nevi digitally to find changes over time.

Parts[3]

1. Magnifier (10x).
2. Non-polarized light source.
3. Transparent plate.

4. Oil or fluid is placed on the lesion as fluid eliminates reflection of light from the surface of the skin allowing visualization of color and structure down to the papillary dermis **(Fig 1)** [4].

5. Recently, new systems utilizing polarized light may achieve similar results without the need for liquids **(Fig 1)** [4].

Fig 1: Optics of polarized & non-polarized light in dermoscopy [4]
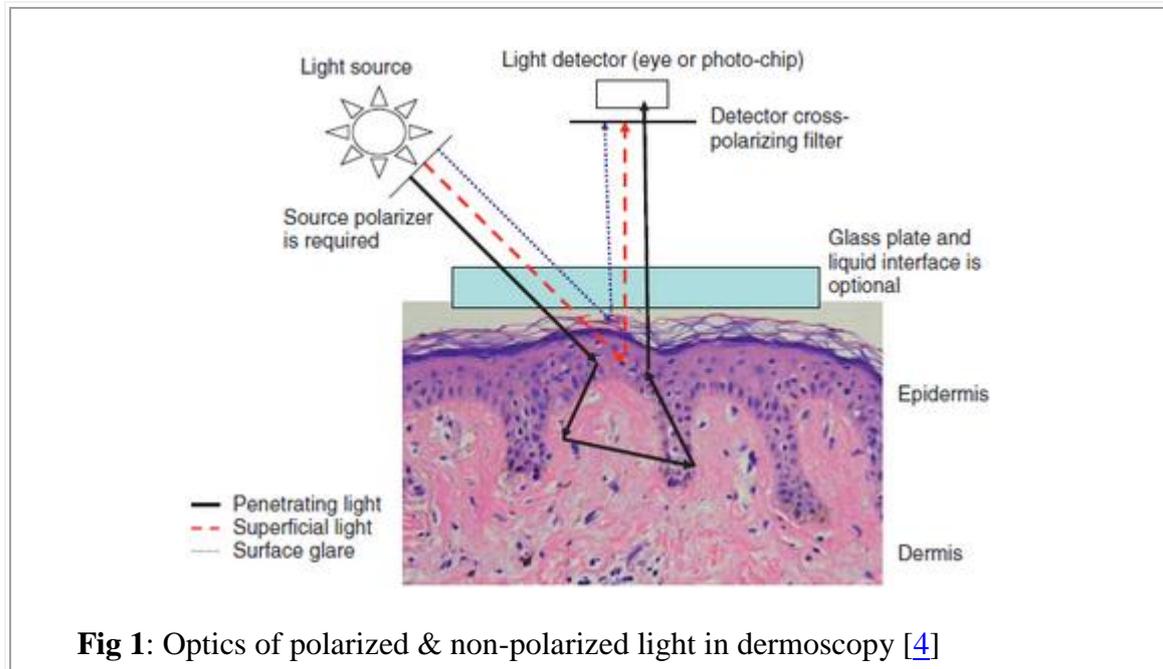
Applications:

(I) Classic dermoscopy

It aids in the diagnosis of pigmented and non-pigmented skin tumors including melanocytic, non-melanocytic, benign, and malignant skin tumors. There are two major approaches; the Heuristic approach and the Analytical approach. The Heuristic approach is called "The Pattern Analysis" and utilizes a 2 step algorithm **(Fig 2)**. In the first step of decision making, the physician decides whether a lesion is of melanocytic or non-melanocytic origin through the following seven steps [5]

Fig 2: The Pattern Analysis (2 Step Algorithm) [4]
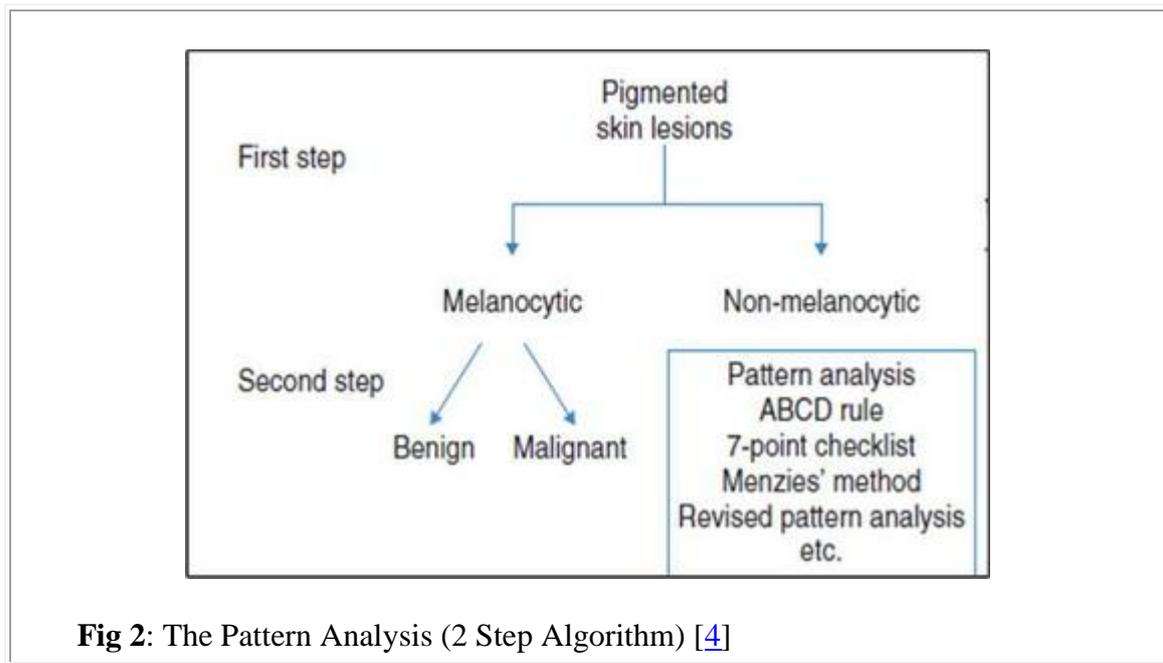
- Level 1: Criteria of Melanocytic Lesions

The lesion is considered of melanocytic origin if any structure of the following is present; pigment network **(Fig 3.a)**, branched streaks **(Fig 3.b)**, streaks, negative network **(Fig 3.c)**, aggregated globules **(Fig 3.d)**, homogenous blue pigmentation **(Fig 3.e)**, pseudo-network (face) **(Fig 3.f)**, or parallel pattern (palms, soles, and mucosa) **(Fig 4)**.

Diagnosing the lesion as pigmented in origin allows the physician to proceed to step two to evaluate whether it is benign, suspicious, or malignant.

Dermatofibroma can be also diagnosed at this level, characterized by multiple patterns, the most common of them is a central white structureless area surrounded by fine peripheral pigment network.
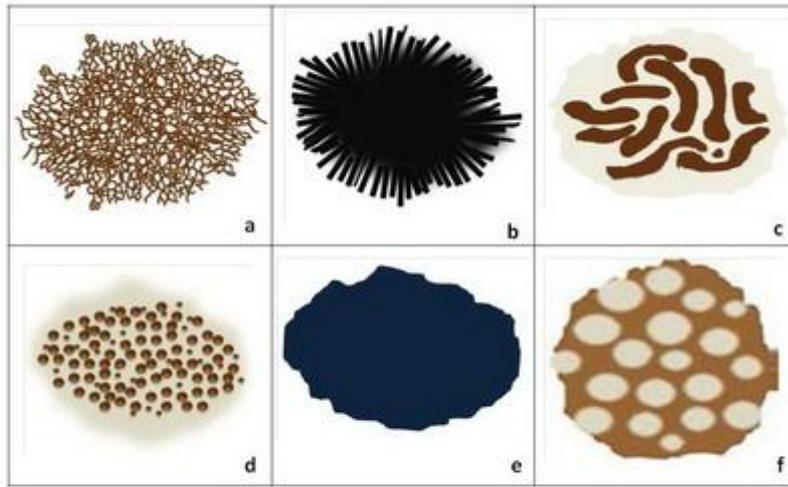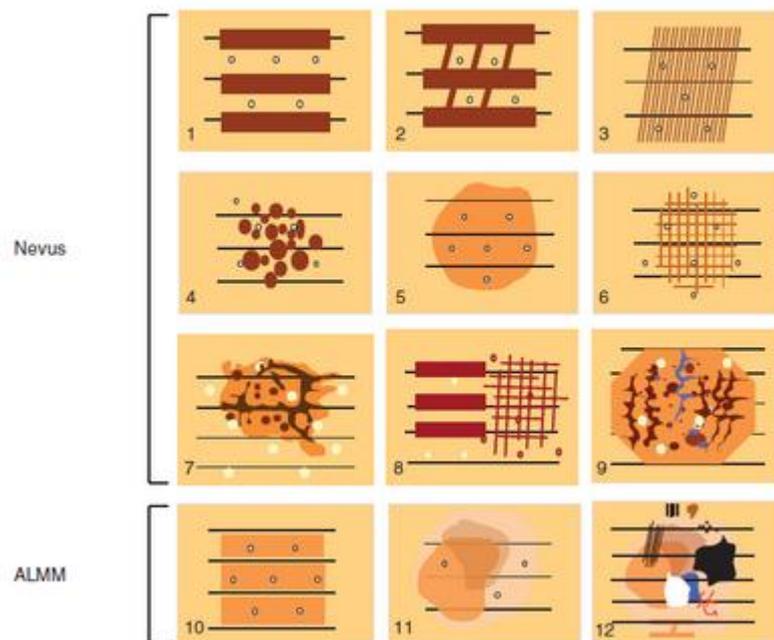
Fig 3: Criteria of melanocytic lesions [6]

Fig 4: Benign and malignant patterns of volar areas (ALMM= acral lentigenous malignant melanoma) [7]

- Level 2: Criteria for basal cell carcinoma

Search for the presence of specific morphologic criteria for basal cell carcinoma which include arborizing blood vessels, leaf-like areas, large blue-gray ovoid nests, multiple blue-gray non-aggregated globules, spoke-wheel-like structures, shiny white areas, or ulceration **(Fig 5)**. [8]

**Fig 5:** Diagram showing BCC dermoscopic features [6]
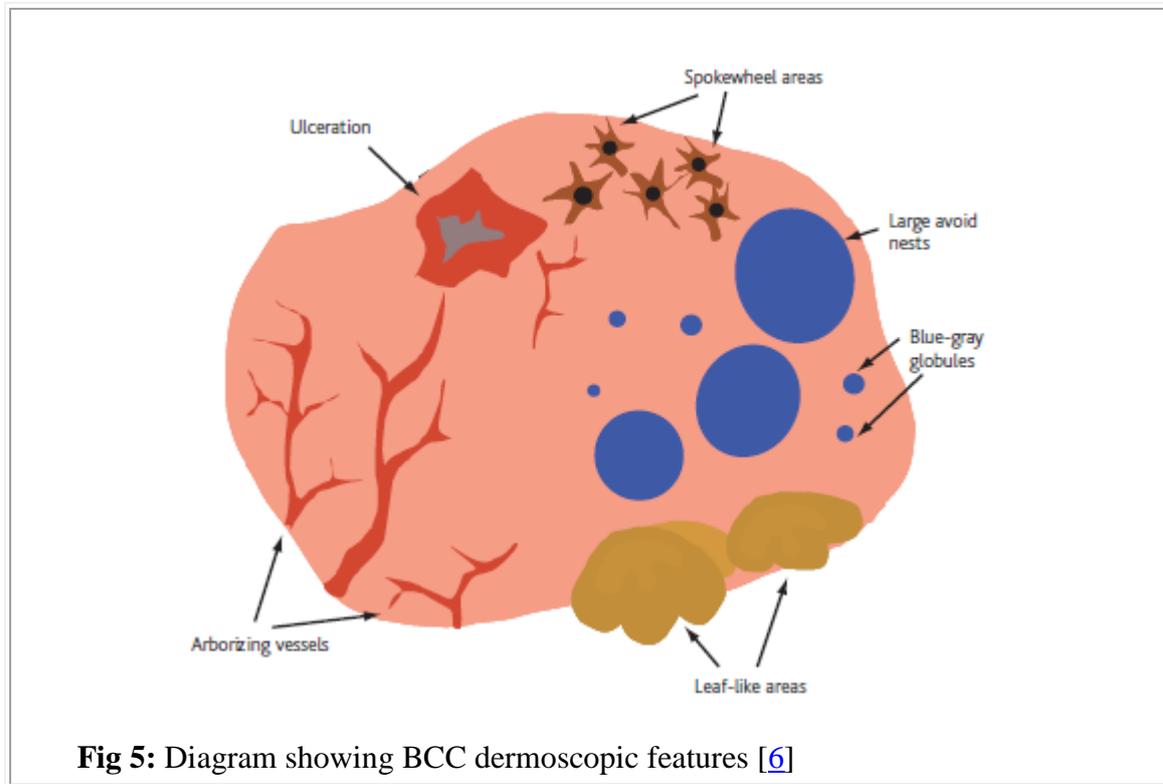
- Level 3: Criteria for seborrheic keratoses

Look for multiple milia-like cysts, comedo-like openings, crypts, moth-eaten borders, network-like structures, "fissures and ridges" that sometimes give a brain-like or cerebriform appearance to the lesion, fat finger like structures), or light brown fingerprint-like structures **(Fig 6)**.[9]

Fig 6: Diagram showing dermoscopic features of seborrheic keratosis [6]
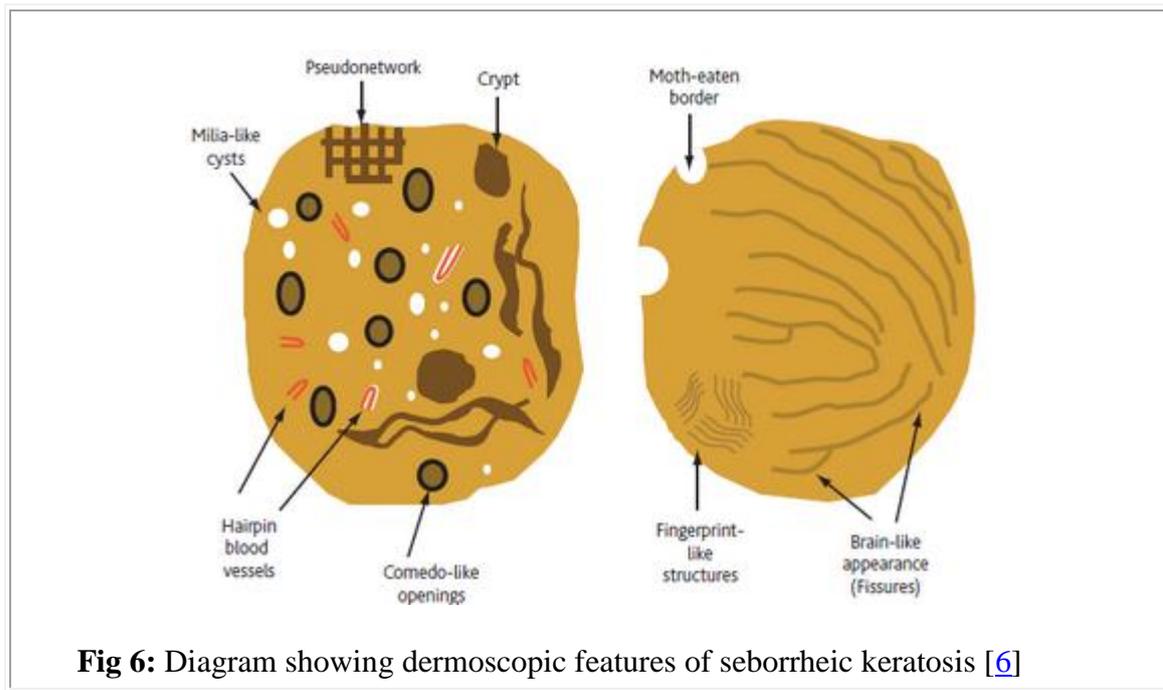
*- Level 4: Criteria for vascular lesions*

The presence of red, maroon, or red-blue to black lacunae (also known as lagoon-like structures), indicates that the lesion is a haemangioma or angiokeratoma **(Fig 7)**.

Fig 7: Diagram showing dermoscopic features of hemangioma [10]
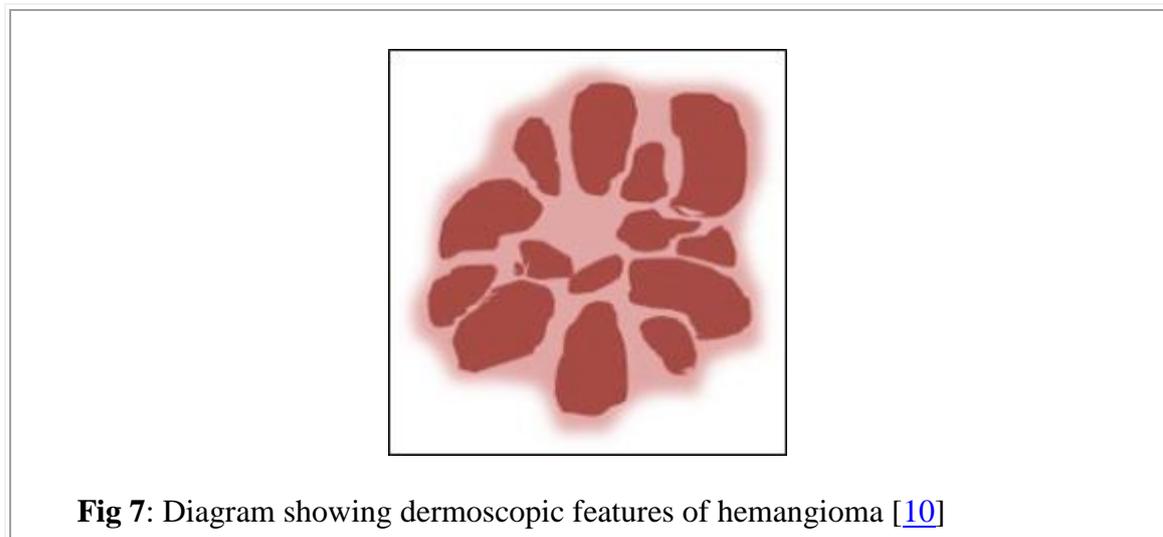
- Level 5: Specific blood vessels in non-melanocytic lesions

If none of the morphologic criteria described in the previous levels can be identified, then the lesion is considered amelanotic or hypomelanotic. In such lesions, the physician may be able to find vascular structures that can assist in the diagnosis. It is important to observe both the morphology and distribution of the vessels. Hairpin vessels surrounded by a whitish halo is a characteristic of keratinizing tumors, such as keratoacanthoma and seborrheic keratosis **(Fig 8a)**. The presence of glomerular vessels, usually aggregated focally at the periphery of the lesion identifies the lesion as a squamous cell carcinoma or

bowen's disease **(Fig 8b)**. The presence of blood vessels arranged like "string of pearls" is a hallmark of clear cell acanthoma **(Fig 8c)** while the presence of crown vessels identifies the lesion as a sebaceous hyperplasia or molluscum contagiosum **(Fig 8d)** [5]

Fig 8: Diagram showing different vascular patterns seen in non-melanocytic lesions [2]
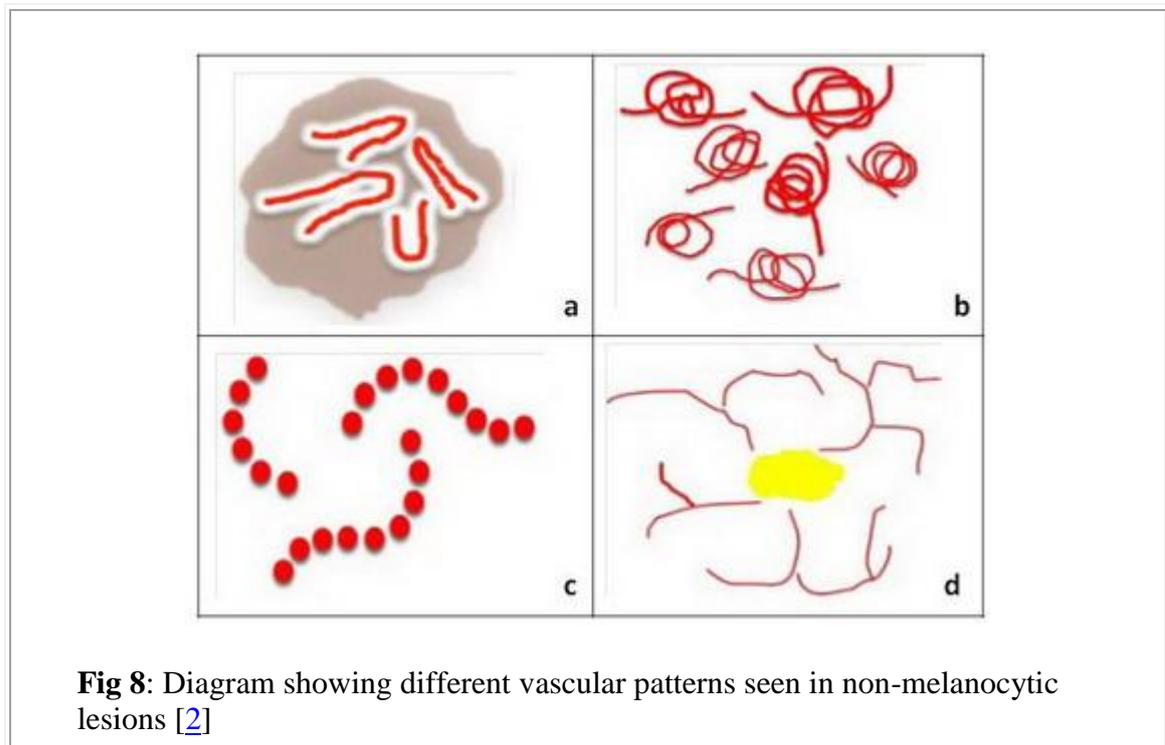
- Level 6: Specific blood vessels in melanocytic lesions

The presence of predominantly comma shaped blood vessels is a hallmark of intradermal nevi. The blood vessel morphology encountered in melanoma includes dotted **(Fig 9a)**, linear irregular **(Fig 9b)**, atypical hairpin (serpentine) vessel in a pink background, and cork screw **(Fig 9c)**, tortuous vessels or milky red areas **(Fig 9d)** . If more than one type of vessel morphology is seen within the same lesion, the vascular pattern is termed "polymorphous" **(Fig 9e)**, which is the most common pattern associated with melanoma. Lesions that do not display any of the structures mentioned in steps 1-6 are considered "structureless" and for such lesions one needs to proceed to level 7 **(Fig 10)** [5]
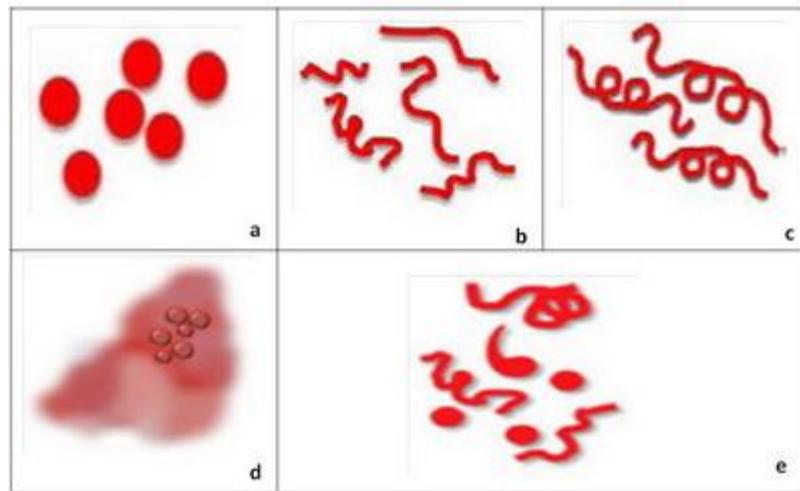
Fig 9: Diagram showing different vascular patterns seen in melanocytic lesions [2]

- Level 7: "Structureless" lesions

This category includes all lesions that fail to reveal any specific diagnostic structures to help classify them as melanocytic or as one of the non-melanocytic lesions. For example, the presence of fine dots, peppering, blue white veil, crystalline structure, and blotches may be present in these lesions. Although these structures cannot be used to differentiate melanocytic from non-melanocytic lesions, they can be clues that aid in correctly identifying melanomas and some basal cell carcinomas. These lesions either should be biopsied or should be subjected to short-term mole monitoring in an attempt to ascertain their biologic behavior [5]
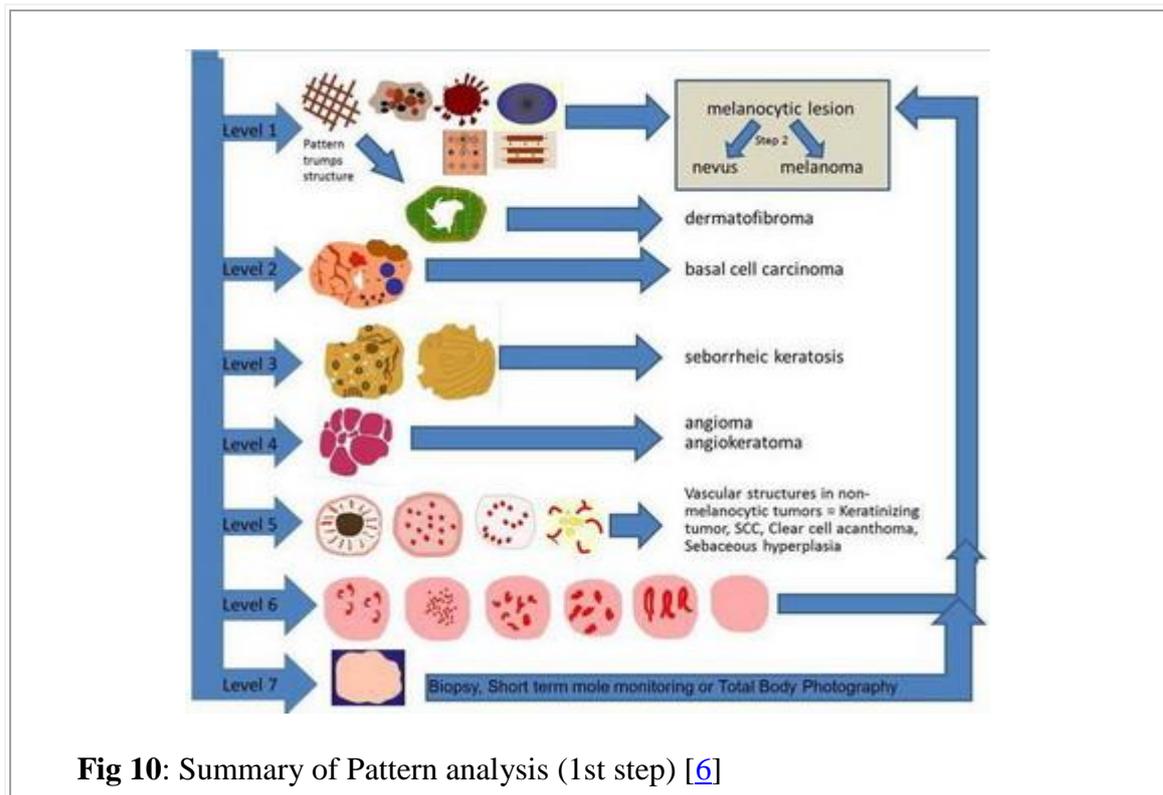
Fig 10: Summary of Pattern analysis (1st step) [6]

The second step of decision making is deciding whether the melanocytic lesion is benign, suspect or melanoma. To accomplish this, many different approaches have been proposed.

Revised 7- point checklist (Fig 11) [11]

The seven-point checklist is based on the detection of seven dermoscopic features commonly associated with melanoma

- Atypical pigment network,
- Blue whitish veil,
- Atypical vascular pattern,
- Irregular streaks,
- Irregular dots or globules,
- Irregular blotches,
- Regression structures.

A score is calculated by summing points giving one point for each criterion. If the lesion scores 1 or more, then it should be examined carefully as it's suspicious for melanoma.
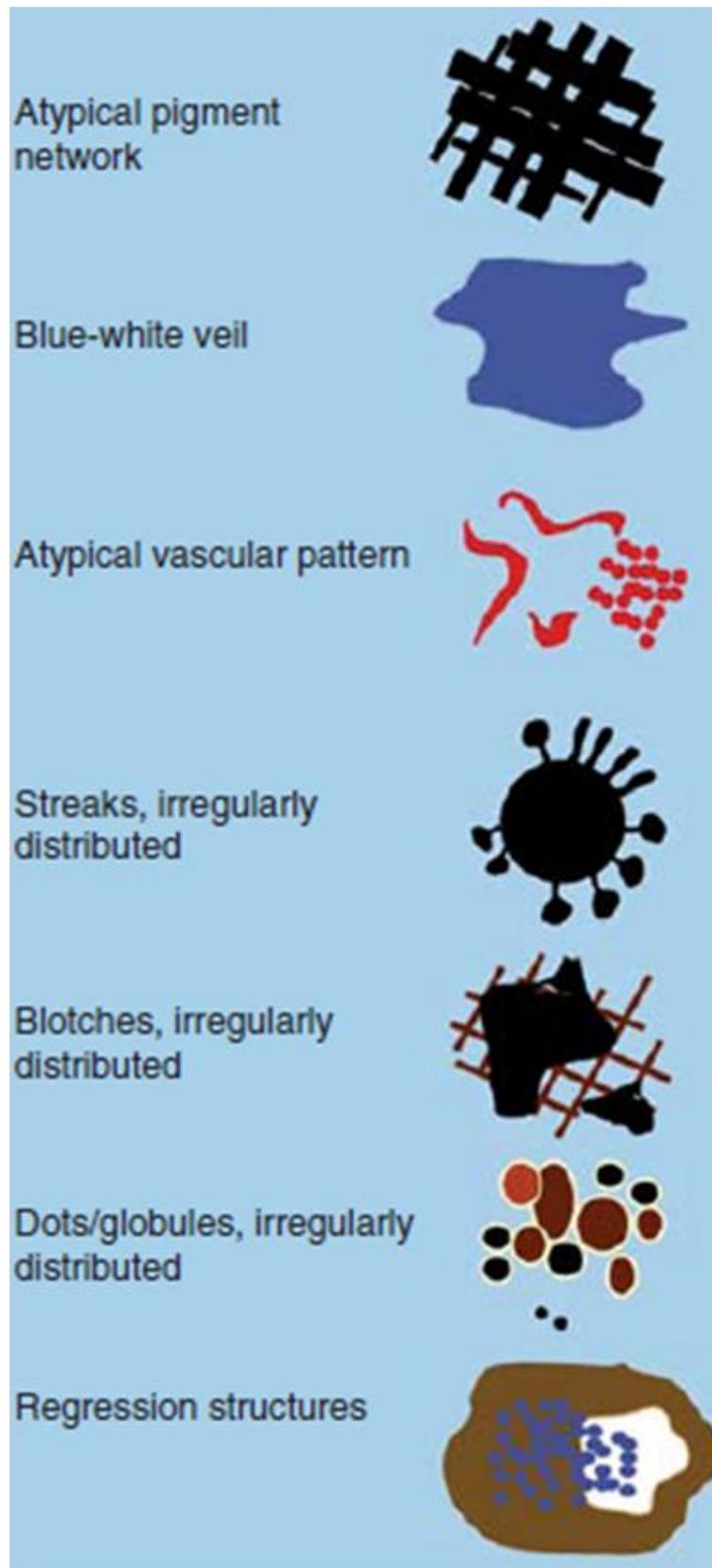
Fig 11: The revised seven point checklist [12]

Three-Point Checklist [13]

- Asymmetry: is defined as asymmetry in the distribution of dermoscopic colors and/or structures in one or two perpendicular axes.
- Atypical network: is defined as pigmented network lines that are focally thickened and distributed in an irregular or disorganized manner.
- Blue-white structures: includes any blue and/or white color visible within the lesion.

The presence of more than one of the above three criteria is suggestive of

a malignancy (basal cell carcinoma or melanoma).

Pattern analysis [14]

Benign nevus patterns include: (**Fig 12**)

- Diffuse reticular,
- Patchy reticular,
- Peripheral reticular with central hypopigmentation,
- Peripheral reticular with central hyperpigmentation,
- Peripheral reticular with central globules,
- Globular,
- Peripheral globules,
- Starburst,
- Homogenous,
- Two component,
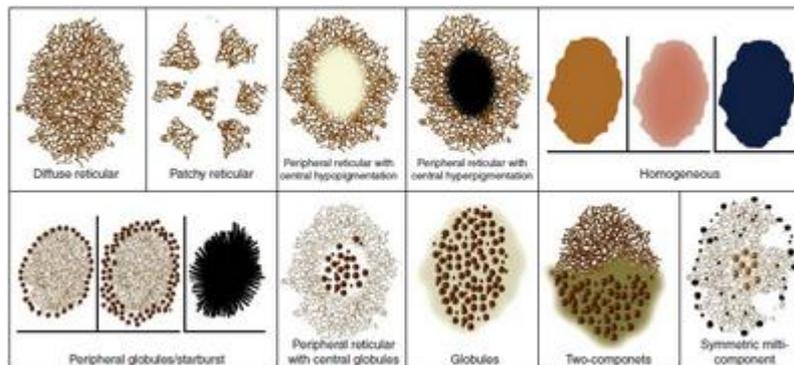- Symmetrical multicomponent.

Fig 12: Diagram showing Dermoscopy benign nevus patterns [4]

Melanoma specific features include: (**Fig 13**)

- Atypical pigment network,
- Streaks (Radial streaming and pseudopods),
- Negative pigment network,

- Crystalline structures,
- Atypical dots, and globules,
- Off centered blotches,
- Regression structures,
- Blue white veil on raised areas,
- Atypical vascular structures,
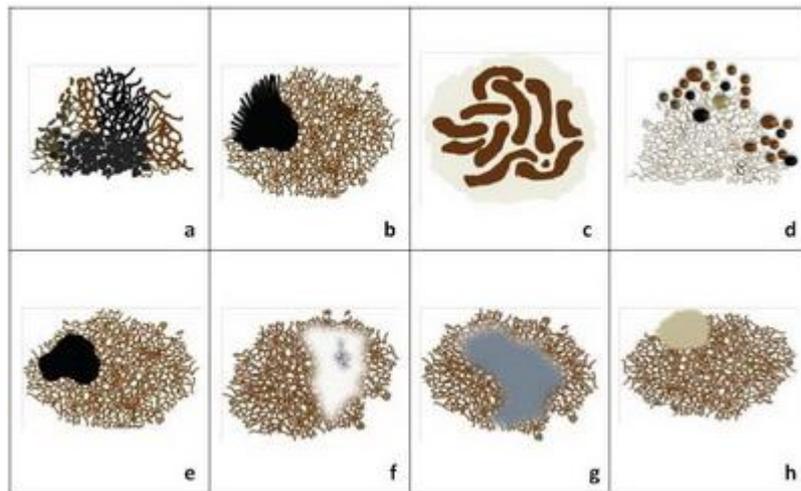- Peripheral brown structureless areas.

Fig 13 : Diagram showing melanoma specific features [4]

Revised pattern analysis [15] (Analytical approach)

Basic Elements **(Fig 14)**

All patterns observed in dermoscopy are composed of

five simple geometric elements. These basic elements are:

- Lines
- Dots
- Clods
- Circles
- Pseudopods
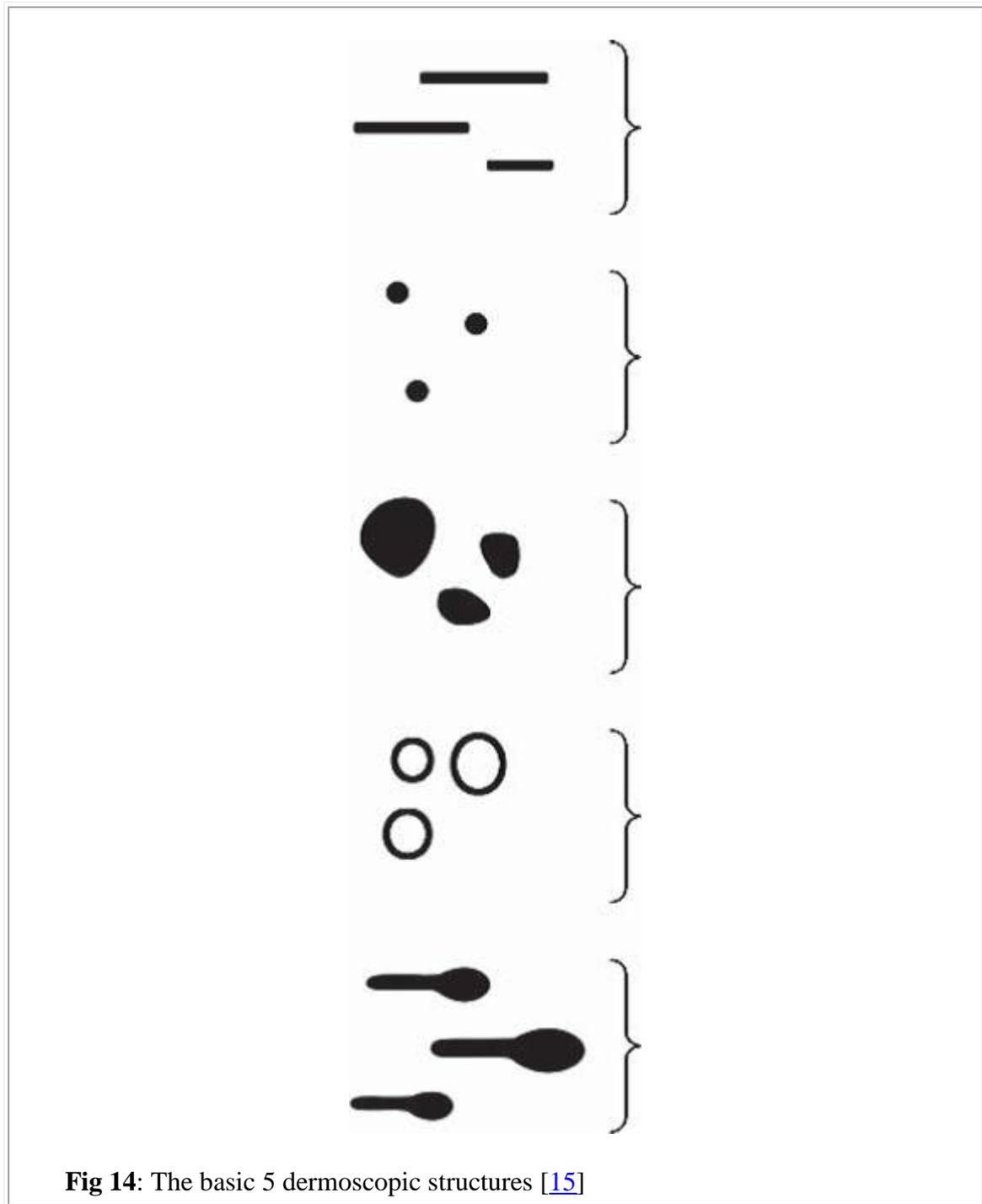
Fig 14: The basic 5 dermoscopic structures [15]

Patterns Formed by Basic Elements **(Fig 15,16)**

A pattern is built up of multiple repetitions of the same single basic element. There is also a pattern "structureless," an area characterized by the absence of any of the basic elements, or at least with no basic element dominating. Lines can be arranged to form five different patterns: reticular, branched, parallel, radial, and curved.

Fig 15: The dermoscopic lines patterns [15]

Fig 16 : Dermoscopic basic structures patterns [15]
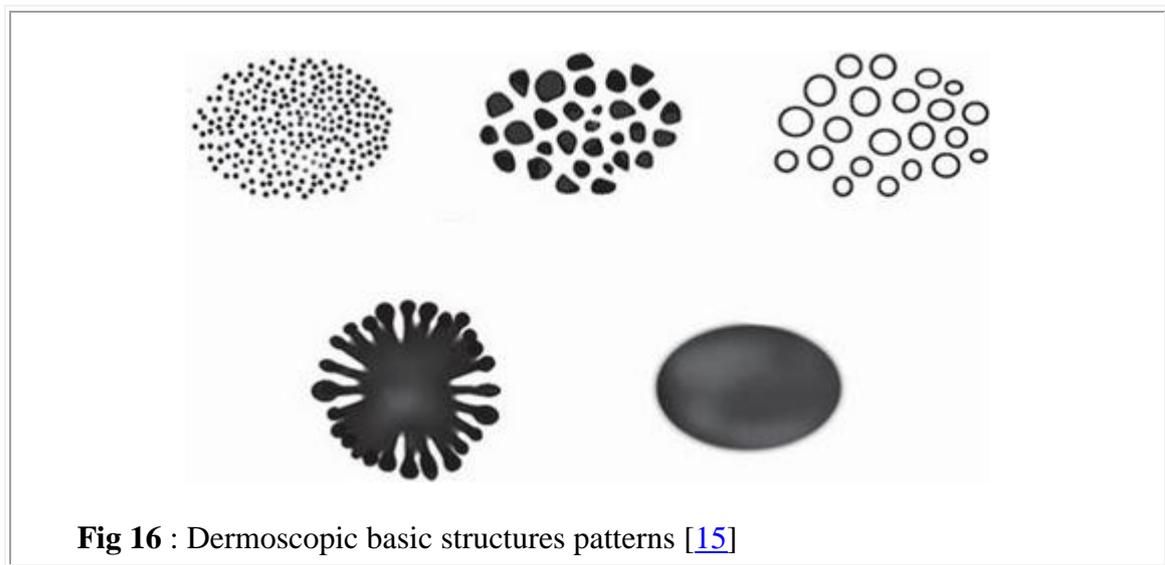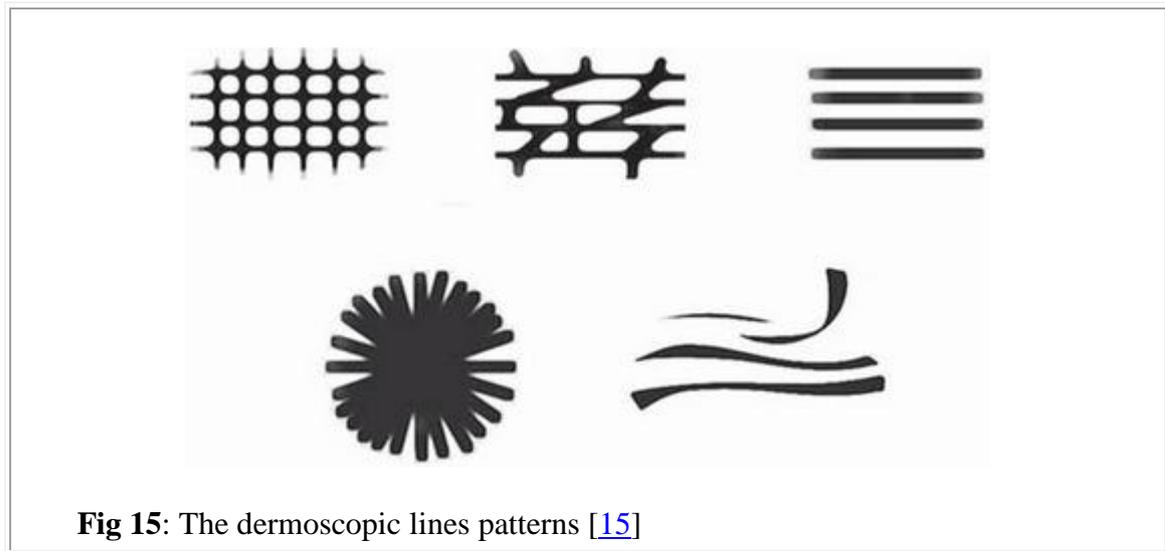
Colors

Colors seen in dermoscopy are created by various combinations of keratin, melanin, blood (including serum in crusts), collagen, and foreign material. The color of melanin varies greatly depending on localization in the epidermis or dermis **(Fig 17)**.

Fig 17: Different colors seen in dermoscopy [15]
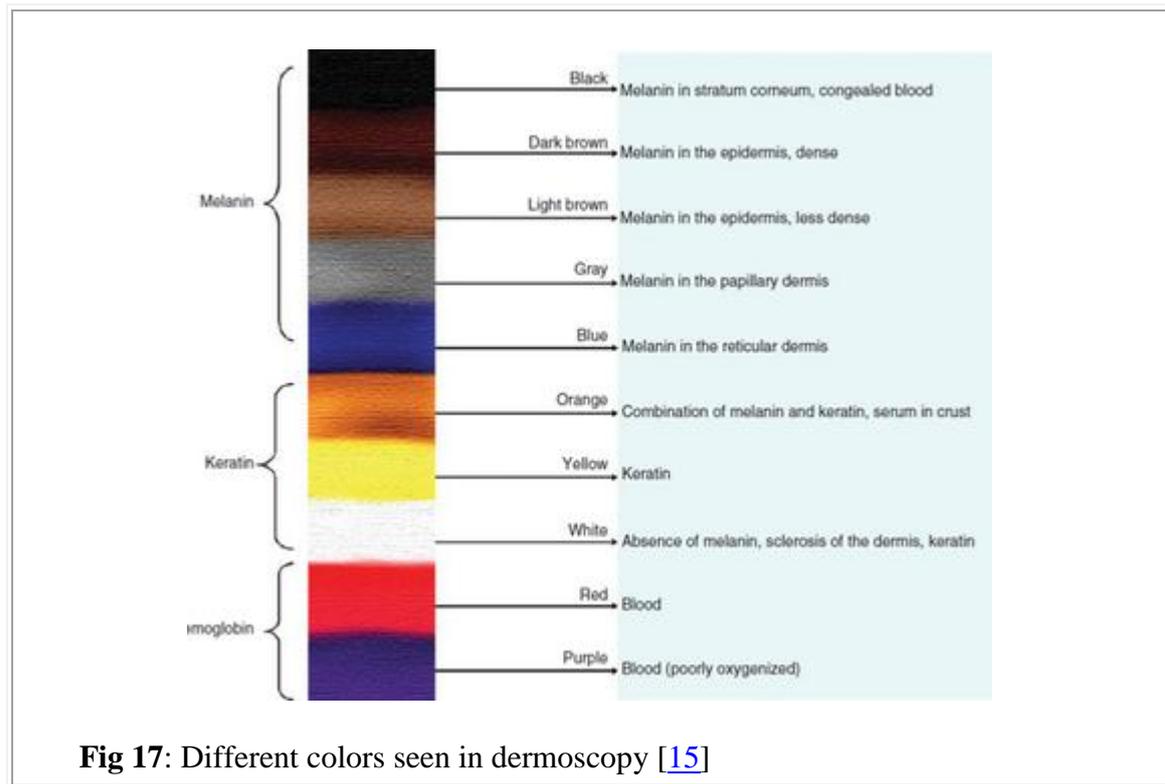
Vessels

Morphology: **(Fig 18)**

- Dots (A)
- Clods (B)
- Lines
- Straight (C)
- Looped (D)
- Curved (E)
- Serpentine (F)
- Helical (G)
- Coiled (H)
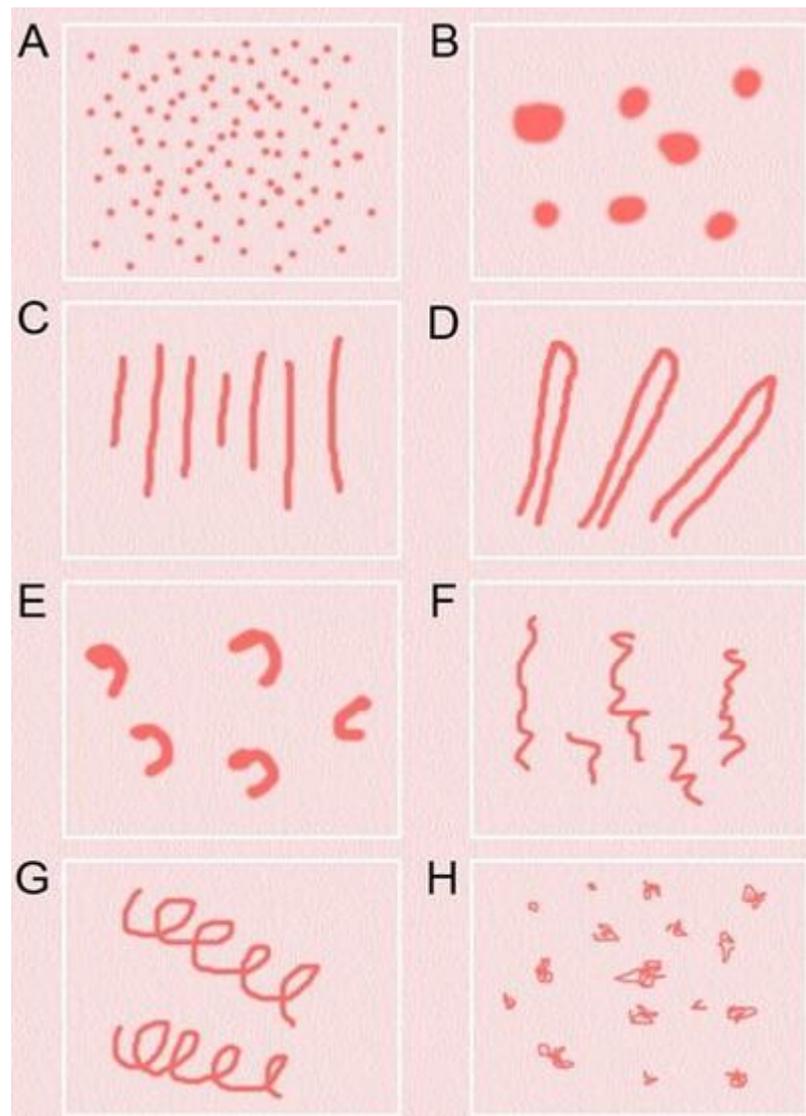
Fig 18: The basic dermoscopic vascular structures[15]

Distribution (**Fig 19**)

- Random (A)
- Clustered (B)
- Serpiginous (C)
- Linear (D)
- Centered (E)
- Radial (F)
- Reticular (G)
- Branched (H)
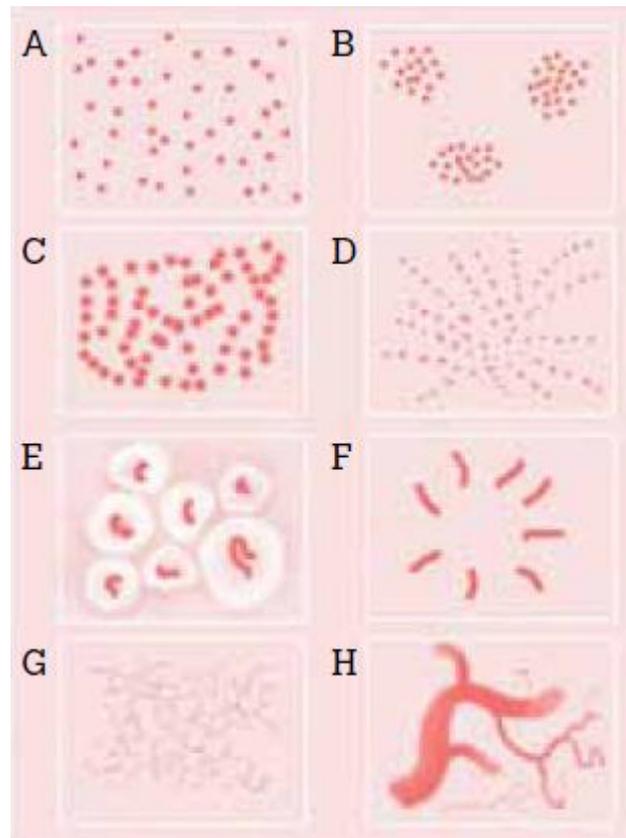
Fig 19: The basic dermoscopic vascular patterns[15]

The analytical approach is based on the Chaos & Clues method, any pigmented skin lesion is then classified into either chaotic or not based on its color, pattern but not on outline or shape. If the lesion is not chaotic, then no further intervention is needed, but if chaotic then, you should search for a clue for the diagnosis of melanoma which are:

- Grey or blue structures
- Eccentric structureless areas
- Thick reticular lines
- Black peripheral dots or clods
- Radial lines or pseudopods (segmental)
- White lines
- Parallel ridge lines
- Polymorphous vessels
- Polygons

The only exceptions for this rule is the growing nodules in adults as well as facial lesions with any grey colour and acral volar lesions with parallel ridge pattern.

ABCD rule (Table 1) [16]

		Points	Weight factor	Subscore range
Asymmetry	Complete symmetry	0	1.3	0-2.6
	Asymmetry in 1 axis	1		
	Asymmetry in 2 axis	2		
Border	8 segments, 1 point for abrupt cut-off of pigment	0-8	0.1	0-0.8
Color	1 point for each color:	1-6	0.5	0.5-3.0
	White			
	Red			
	Light brown			
	Dark brown			
	Black			
	Blue-gray			
Differential structures	1 point for every structure:	1-5	0.5	0.5-2.5
	Pigment network			
	Structureless areas			
	Dots			
	Globules			
	Streaks			
			Total score range:	1.0-8.9

Table 1: The ABCD rule of dermoscopy

Menzies method [17]

To diagnose melanoma, both of the following negative features must not be found: a single color or point and axial symmetry of pigmentation. Additionally, at least one positive feature of the following must be found; blue-white veil, multiple brown dots, pseudopods, radial streaming, scar-like depigmentation, peripheral black dots or globules, multiple colors (5 or 6), multiple blue/gray dots or broadened network.

(II) Trichoscopy: [18]

It is that branch of dermoscopy dealing with hair and scalp disorders. It is rapidly gaining acceptance in the diagnosis and follow up treatment of cicatricial and non cicatricial alopecias. It can be used also in diagnosing different hair shaft disorders as well as infections and infestations.

Applications:

Non- cicatricial alopecia: **(Fig 20, 21)**

Alopecia areata

The hallmark trichoscopic features of alopecia areata are regularly distributed yellow dots, micro-exclamation mark hairs, tapered hairs, black dots, broken hairs, and upright and regularly coiled (circle, pigtail) re-growing hairs. Trichorrhexis nodosa may be observed, especially in active, early alopecia areata. It must be emphasized that micro-exclamation mark hairs are not pathognomonic for alopecia areata. Trichoscopy of alopecia areata may differ depending on the disease activity, severity and duration.

Active hair loss	Long standing inactive disease	Hair regrowth
Black dots	Yellow dots	Upright re-growing hair
Micro-exclamation marks	Vellus hair	Vellus hair
Broken hair	Follicular openings may not be visible	Pigtail hair
Monilethrix like		
Trichorrhexis nodosa		

Table 2: Trichoscopic features of alopecia areata

Male and female AGA share similar trichoscopic features, including hair shaft thickness heterogeneity, thin hairs, yellow dots, perifollicular discoloration (the peripilar sign), an increased proportion of vellus hairs, and a large number of follicular units with only one emerging hair shaft. Thin wavy hair and honeycomb hyperpigmentation often coexist as additional, unspecific features. These features are more pronounced in the frontal compared to the occipital region.
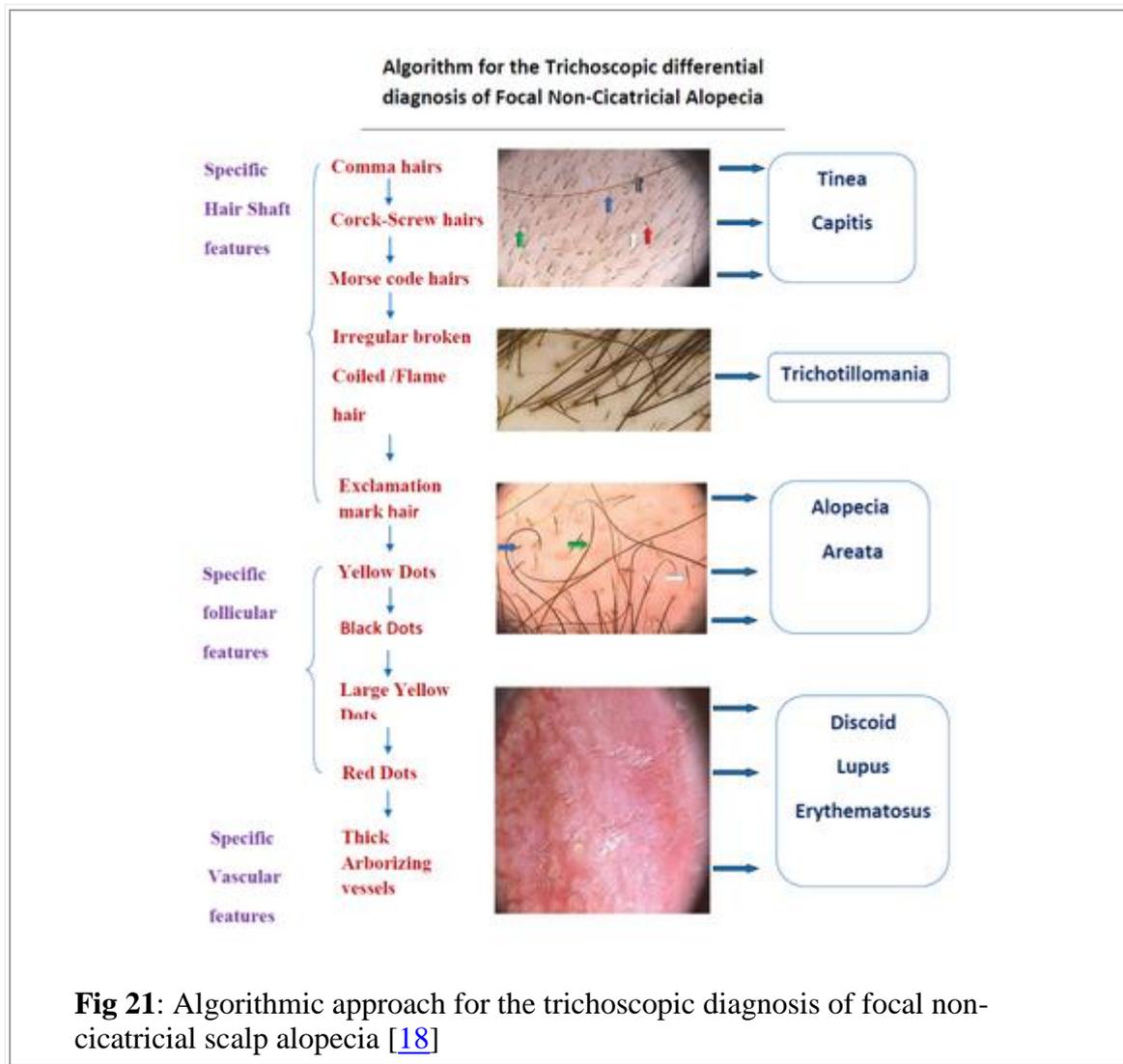
Telogen effluvium

Trichoscopy has limited value in diagnosing telogen effluvium. Frequent, but not specific, findings include the presence of empty hair follicles, a predominance of follicular units with only one hair, perifollicular discoloration (the peri-pilar sign), and upright re-growing hairs with lack of features of any other disease. There is no significant difference between the findings in the frontal area and those of the occipital area, which differentiates telogen effluvium from androgenetic alopecia.

Trichotillomania

Trichoscopy of trichotillomania is characterized by a chaotic pattern of diverse features related to hair fracturing. The most characteristic features are hairs broken at different lengths, short hairs with trichoptilosis (split ends), irregular coiled hairs, amorphous hair residues, and black dots.

Tinea capitis

Dermoscopy of tinea capitis shows two typical features; comma hairs (curved fractured hair shafts) and corkscrew hairs. Broken and dystrophic hairs also are seen.

Fig 20: Algorithmic approach for the trichoscopic diagnosis of diffuse non-cicatricial scalp alopecia [18]

Fig 21: Algorithmic approach for the trichoscopic diagnosis of focal non-cicatricial scalp alopecia [18]

Cicatricial alopecias **(Fig 22)**

Lichen planopilaris

Trichoscopic features of active lesions include; perifollicular scaling (scales entangling hair shafts up to 2-3 mm above the scalp surface in a tubular manner), hair casts, elongated linear blood vessels and violaceous areas. Inactive lesions show irregular, large white dots (fibrotic white dots), white areas, milky red areas (strawberry ice cream color) and tufted hairs.

Frontal fibrosing alopecia

Scalp lesions show lack of follicular openings, homogenous ivory-colored background, minor perifollicular scaling, perifollicular erythema, follicular openings with only one hair at the hair-bearing margin, perifollicular brown or brown-violet areas (in dark-skinned patients). While eyebrows lesions show multiple regularly distributed red dots in early phase of disease and multiple regularly distributed red or gray to gray-brown dots in advanced cases.

Discoid lupus erythematosus

Active (early) lesions show thick arborizing vessels, large yellow dots corresponding to the follicular keratotic plugs, fine interfollicular scaling, scattered brown discoloration, red dots, blue-gray dots (on dark or sun-exposed skin). On the other hand, inactive (end-stage) lesions show loss of follicular openings, pink areas, white areas, arborizing vessels and yellow dots containing thin spider vessels (in prefibrotic lesions).

Folliculitis decalvans

Active disease show tufts of five or more hairs in one follicular unit, yellow follicular pustules, yellowish tubular scaling with collar formation, yellow discharge, starburst sign corresponding to folds of epidermal hyperplasia with elongated looped or coiled vessels arranged in concentric perifollicular pattern. Late stage (inactive disease), milky red areas lacking follicular openings or white areas lacking follicular openings are usually seen.

Dissecting cellulitis

Trichoscopic features of active dissecting cellulitis include; yellow structureless areas, yellow 3D (soap bubble) dots with or without hair shafts, black dots, pinpoint-like vessels with a whitish halo, cutaneous clefts with emerging hairs and hair tufts.

Pseudopelade of Brocq

Trichoscopic features of pseudopelade of Brocq include; no follicular openings, smooth white areas, dystrophic hairs at the periphery of the lesion with no features indicative of other types of cicatricial alopecia.
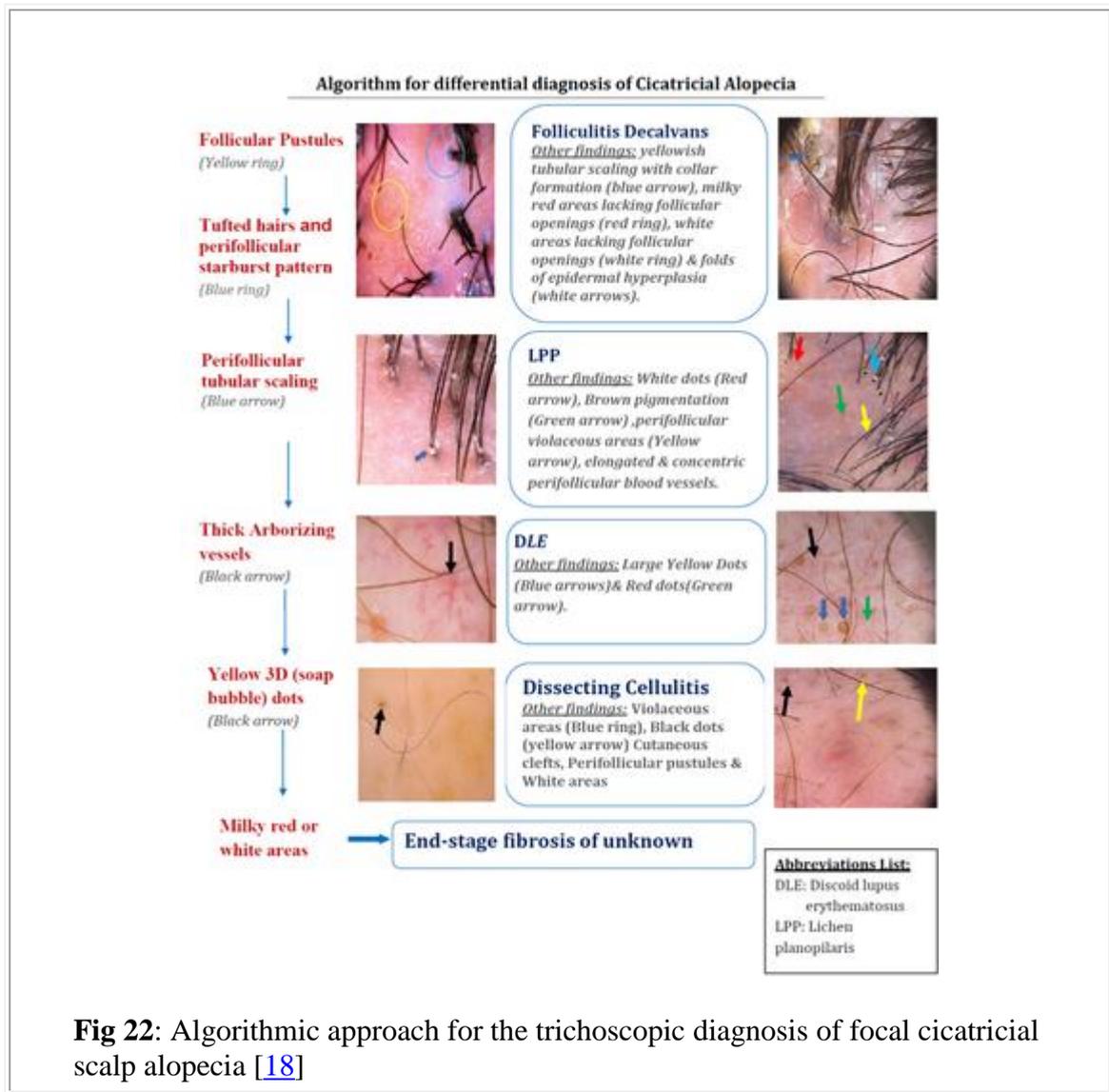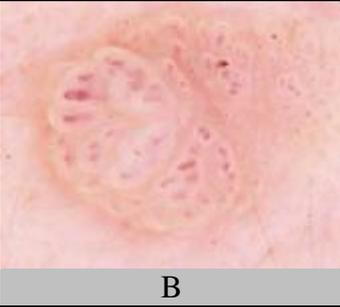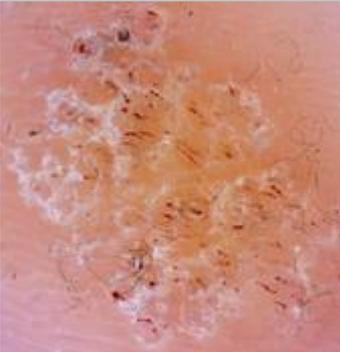
Fig 22: Algorithmic approach for the trichoscopic diagnosis of focal cicatricial scalp alopecia [18]

Hair shaft abnormalities

They can also be seen as in cases of fractured hair in the form of: trichoptilosis, trichoschisis/trichoclasis and Irregular fractures caused by mechanical force or trichorrhexis invaginata, narrowing as in cases of monilethrix, monilethrix-like congenital hypotrichosis, monilethrix-like hairs (Pohl-Pinkus constriction), pseudomonilethrix, tapered hairs and exclamation mark hairs, node-like appearance as in cases of trichonodosis, trichorrhexis nodosa, Bamboo hairs (trichorrhexis invaginata) and hair casts, curls and twists as in pigtail hairs (circular or oval), coiled hairs, comma hairs, corkscrew hairs, z-hairs (zigzag hairs), pili torti or woolly hairs, bands as in cases of interrupted medulla, pili annulati and interrupted (Morse code-like) hairs and short hairs as in cases of upright re-growing hairs, vellus hairs, tulip hairs, block hairs, i-hairs, broom hairs and flame hairs.

(III) Entomodermoscopy:

It is the one diagnosing skin infections and infestations

Diagnosis		Dermoscopy pattern	
Viral	Facial-plane warts	Regularly distributed dotted vessels on a brown to flesh colored background, often intermingled by whitish lines [19].	A
	Common warts	Frogspawn patterns. Looped or dotted vessels within papillae that are typically whitish [20].	B
	Plamoplantar warts	Yellowish structureless pattern typically with brownish to reddish lines or dots (corresponding to hemorrhages) [21].	C
	Genital warts	Whitish reticulation [19].	D

	Molluscum contagiosum	Polylobular whitish structureless areas in the center surrounded by elongated blurred telangiectasias [22].	E
Fungal	Tinea nigra	Fine superficial wispy-like gray to brownish lines that do not follow the anatomic structures of the furrows or ridges on glabrous skin. Clue: The superficial pigmentation can be easily removed by scraping the stratum corneum with a scalpel [23].	F
Bacterial	Folliculitis	White to yellow dot filling the hair follicle surrounded sometimes by dotted vessels [19].	G
	Lupus vulgaris	Fine focused telangiectasias on a typically yellow to golden background. Sometimes a few milia-like cysts or whitish lines	H

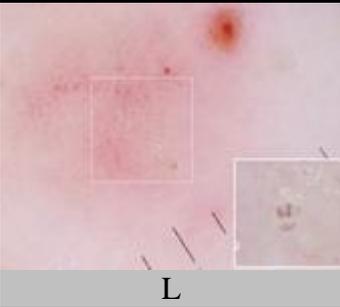|			
		can be present [24].	
Parasitic	Cutaneous larva migrans	Translucent brownish structureless areas in a segmental arrangement, which corresponded to the body of the larva, whereas the empty burrow revealed red-dotted vessels on dermoscopy [19].	I
	Ixodex ricinus	Double pair of anterior legs protruding from the surface of the skin, whereas the chitinous body is seen as a brown to gray translucent "shield" with pigmented streaks [25].	J
	Lice/nits	• Vital nits: ovoid, brown structures fixed to the hair shaft • Empty nits: cases are translucent and typically show a plane and fissured	K

		free ending [26].	
	Scabies	Brown triangle at the end of a curved whitish line (jet with contrail) [27].	L
	Tungiasis	Central pigmented ring with a pore in the middle, eccentric gray-bluish blotch, in a whitish background [28].	M

Fig23: Different types of skin infections and infestations detected by dermoscopy F,I J,K [19], A,B,C,D,G,L,M [29]

(IV) Inflammoscopy:

This is the one involved with inflammatory skin diseases.

Diagnosis	Dermoscopic features	
Lichen planus	Radially arranged, horizontally oriented red lines or red dots surrounding reticular whitish striae (Wickham's striae) [30].	A
Psoriasis	Regularly distributed dotted vessels and scales [31].	B
Pityriasis rosea	Central mixed vascular pattern and peripheral collaret of scales [32].	C
Eczema	Dotted vessels in a patchy arrangement and yellow scales. [33]	D

Fig 24: Different types of inflammatory skin diseases detected by dermoscopic examination A,B,C,D [33]

(V) Capillaroscopy:

It evaluates the nail fold capillaries for the screening of autoimmune diseases.
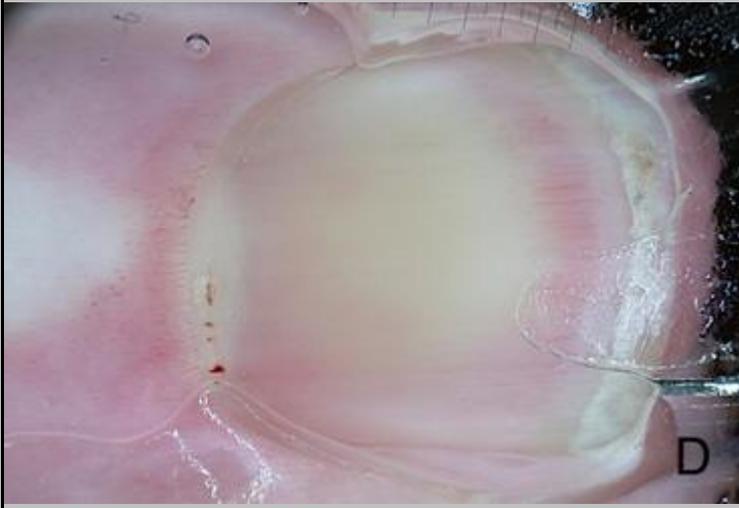
Diagnosis	Definition/diagnostic significance
Scelroderma Dermatomyositis (SD) pattern[34]	Two or more of the following patterns in at least two nail folds: • Enlargement of the capillary loops • Loss of capillaries • Disorganization of the distribution of the capillaries • Budding capillaries • Twisted capillaries and capillary hemorrhages (extravasates)
Dermatomyositis[35]	SD pattern
Lupus erythematosus[35]	SD pattern/mixed vascular pattern including giant capillaries or loss of capillaries
Mixed Connective Tissue Disease (MCTD) [35]	SD pattern
Raynaud phenomenon without evidence of underlying CTD[34]	SD pattern/twisted capillaries and extravasation of erythrocytes
Scleroderma[36]	SD pattern

Fig 25 : Dermoscopic examination of nail fold capillaries in scleroderma patient showing enlarged capillary loops with hemorrhage [33]

(VI) Dermoscopy for treatment decision and monitoring: [33]

It is used for taking decisions preoperatively regarding lesions margins and extension, and in follow up especially after non-invasive treatment modalities.

Fig 26. Dermoscopy of BCC before and after topical treatment [33]
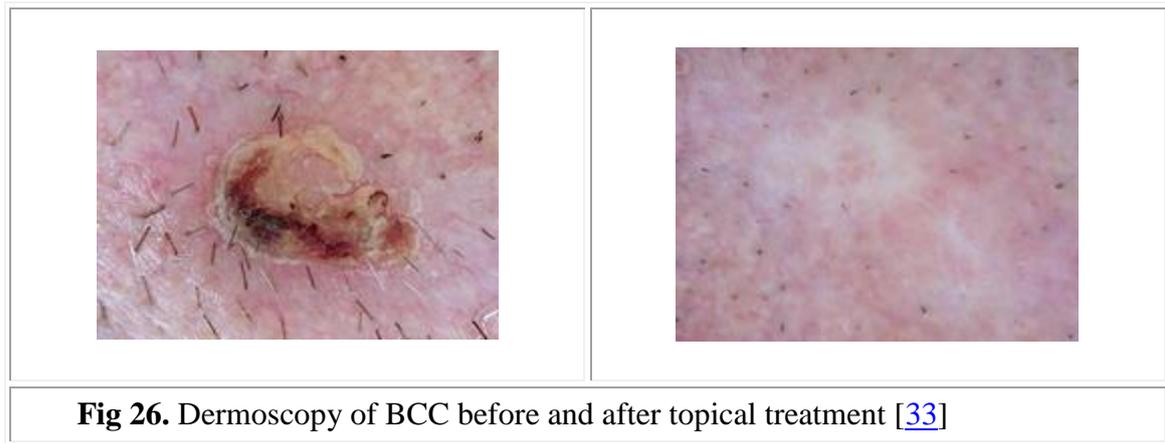
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