Dermoscopy and dermatopathology correlates of cutaneous neoplasms

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Learning objectives
After completing this learning activity, participants should be able to discuss the separation between dermatology and dermatopathology; identify why dermoscopy can act as the link between dermatology and pathology; describe the colors in dermoscopy and its relevance in terms of histologic analysis; describe the dermoscopic findings and the histological correlates of melanocytic lesions; and describe the dermoscopic findings and the histological correlates of nonmelanocytic lesions.

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Dermoscopy is increasingly used by clinicians (dermatologists, family physicians, podiatrists, doctors of osteopathic medicine, etc) to inform clinical management decisions. Dermoscopic findings or images provided to pathologists offer important insight into the clinician's diagnostic and management thought process. However, with limited dermoscopic training in dermatopathology, dermoscopic descriptions and images provided in the requisition form provide little value to pathologists. Most dermoscopic structures have direct histopathologic correlates, and therefore dermoscopy can act as an excellent communication bridge between the clinician and the pathologist. In the first article in this continuing medical education series, we review dermoscopic features and their histopathologic correlates. (J Am Acad Dermatol 2019;80:341-63.)

Key words: dermatopathology; dermatoscopy; dermoscopy; histology; histopathology.

Dermatology and histopathology have traditionally been linked. Biopsy specimens of the skin are easy to obtain, and dermatologists couple their clinical skills with histopathology and use clinical information to tailor their histopathologic differential diagnosis. In the United States, the creation of dermatopathology in the 1970s uncoupled dermatology and histopathology.[1] While this has led to more specialized physicians who are able to solve challenging cases with greater

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Abbreviations used:

AK: actinic keratosis
BCC: basal cell carcinoma
DEJ: dermoepidermal junction
IDS: International Dermoscopy Society
LM: lentigo maligna
LPLK: lichen planus–like keratosis
SCC: squamous cell carcinoma
SK: seborrheic keratosis

expertise, this separation can also lead to noncongruent diagnoses that ultimately require clinicopathologic correlation.

Dermoscopy is a noninvasive, handheld diagnostic instrument that is equipped with a magnification lens (generally between ×10-20) and a polarized or nonpolarized light source that allows en face visualization of epidermal and dermal structures that are invisible to the naked eye. Dermoscopy is increasingly used by clinicians (dermatologists, family physicians, and physician assistants)[2,3] to inform clinical management decisions. While dermoscopic descriptions or images may be provided to pathologists as part of a requisition form, this information is likely to be of limited value to the pathologist because most have received limited to no training in dermoscopy. In addition, many clinicians using dermoscopy remain unaware of the dermoscopy–histopathologic correlates. Acquiring this knowledge has the potential to not only improve the clinician's diagnostic accuracy but also provide prognostic information, help determine the type of biopsy specimen to obtain, and guide the management of skin cancers. Most dermoscopic structures have direct histopathologic correlates, and therefore dermoscopy offers the ideal bridge to improve clinicopathologic communication.

In the last decade, the description of dermoscopic structures by multiple independent researchers has led to redundant terminology. In an effort to standardize the nomenclature, in 2016 the International Dermoscopy Society (IDS) published a terminology consensus manuscript based on the most commonly used terms.[4,5] In this continuing medical education series we use the consensus terminology and present both the descriptive and metaphoric terms agreed upon by the consensus members.

DERMOSCOPIC STRUCTURES AND COLORS AND THEIR HISTOPATHOLOGIC CORRELATES

Key points

- **Colors seen in dermoscopy depend on the type of chromophores in the skin and their location**
- **Melanin appears in multiple colors (black, brown, gray, or blue) depending on its superficial or deep location**
- **Dermoscopic structures with high specificity for melanocytic neoplasms include network, negative network, angulated lines, aggregated globules, streaks, and parallel patterns on volar surfaces**
- **When these structures are atypical (differences in size, shape, color, or distribution), a diagnosis of melanoma is favored**

Colors in dermoscopy

Colors under the lens of dermoscopy depend on the type and location of the chromophores in the skin.[6-10] The most relevant colors when evaluating cutaneous neoplasms with dermoscopy include black, brown, blue, gray, yellow, orange, red, and white. Most of these colors come from increases of normal components of the skin, such as melanin (brown, black, gray, or blue), blood (red), sebum or keratin (yellow), or collagen (white). However, some colors associated with select dermoscopic structures are associated with specific pathologic features, such as balloon cell changes (white globules),[11] blood thrombosis (black lacunae), or cell xanthomization (homogeneous yellow to orange areas).[12] Melanin is the most common chromophore, and the color will vary from black to brown to blue-gray depending on its concentration and location. Melanin in the stratum corneum or in the superficial epidermis will have a black color; when present in the lower epidermis and near the dermoepidermal junction (DEJ), it will be brown; when present in the papillary dermis it will have a grayish hue; when present in the reticular dermis it will appear blue.[7-9] Colors can provide valuable insight into the depth of a melanocytic lesion and thereby provide possible prognostic information. For example, when grossing a suspected melanoma, sectioning through a blue area (pigment in the reticular dermis) will likely reveal the thickest section of the tumor.

Colors are subject to varying perception because of inherent variation from person to person.[13] Therefore, while the evaluation of color in dermoscopy is important when evaluating a lesion, it can at times distract from diagnostic dermoscopic structures. Evaluating grayscale (black and white) dermoscopic images can remove potential distracting or biasing colors and make dermoscopic structures more conspicuous (Fig 1).[14]

Dermoscopic structures with high specificity for melanocytic neoplasms

Dermoscopy can help differentiate melanocytic from nonmelanocytic lesions through structures that

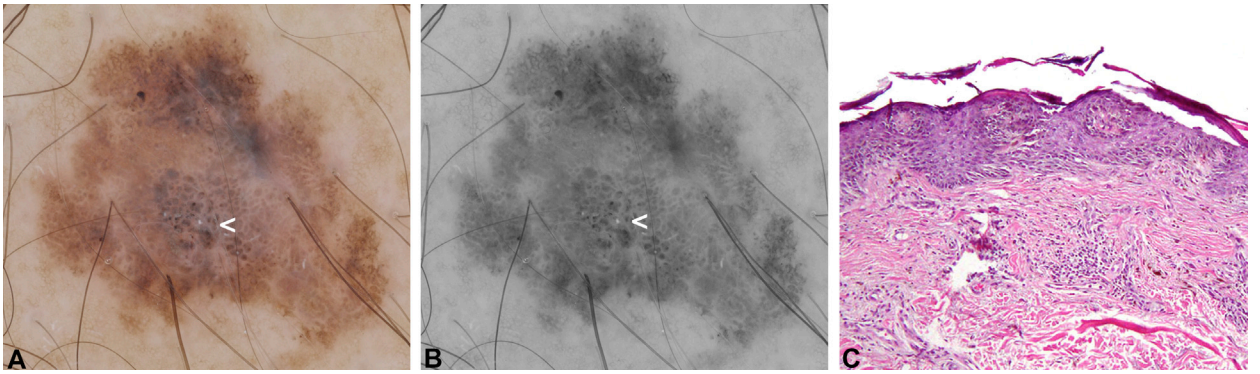
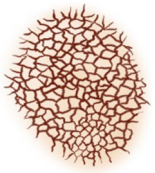
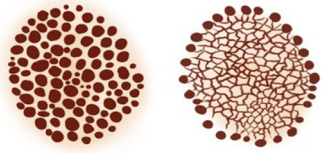


Fig 1. Melanoma arising in a nevus. **A**, Color dermoscopy showing a pigmented lesion with pigment network and central negative network (arrowhead). **B**, Black and white dermoscopy enhances the identification of the negative network (arrowhead). **C**, Histologically, the negative network area revealed the presence of a melanoma arising in a nevus.

Table I. Dermoscopic structures that are relatively specific for melanocytic neoplasms

Schematic illustration	Metaphorical term	Descriptive term	Histopathologic correlate	Clinical association
	Pigment network	Lines, reticular	Lines are caused by pigmented keratinocytes or melanocytes along the dermoepidermal junction; spaces between the lines (holes) correspond to the suprapapillary plate	Regular: melanocytic nevus; irregular: dysplastic nevus, melanoma
	Negative pigment network	Lines, reticular, hypopigmented, around brown clods	Remains to be elucidated, but preliminary work suggests that it corresponds to hypopigmented elongated rete ridges bridging and surrounding large nests of melanocytes within the dermal papillae	Spitz nevus, melanoma
	Angulated lines	Lines, angulated or polygonal	Confluent atypical melanocytes along an attenuated dermoepidermal junction and melanophages in the papillary dermis	Lentigo maligna, melanoma on sun-exposed skin
	Globules	Clods, round or oval, aggregated or circumferential (rim of globules)	Nests of nevomelanocytes at the dermoepidermal junction or dermis	Regular: melanocytic nevus; irregular: dysplastic nevus, melanoma

Continued

Table I. Cont'd

Schematic illustration	Metaphorical term	Descriptive term	Histopathologic correlate	Clinical association
	Streaks (always at the periphery): radial streaming, pseudopods	Radial streaming: lines, radial and segmental; pseudopods: lines, radial and segmental with knobs at their tips	Confluent junctional nests of melanocytes at the periphery	Regular: Reed nevus; irregular: melanoma
	Homogenous blue pattern	Structureless blue	Dermal population of densely pigmented melanocytes	Blue nevus, melanoma

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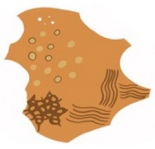
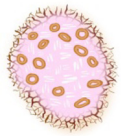
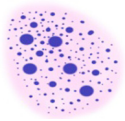
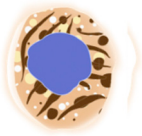
Table II. Dermoscopic features with high specificity for melanocytic neoplasms that can rarely also be seen in nonmelanocytic lesions and their histopathologic correlates

Dermoscopic feature	Cutaneous neoplasm		Histopathologic correlate
Pigment network	Dermatofibroma[17]		Hyperpigmentation of basal keratinocytes
	Ink spot lentigo[18]		Hyperpigmentation of basal keratinocytes
	Accessory nipple[19]		Areolar epidermal hyperplasia
	Seborrheic keratosis/solar lentigo[20,21]		Coalescence of rete ridges with pigmented basaloid cells

Continued

Table II. Cont'd

Dermoscopic feature	Cutaneous neoplasm		Histopathologic correlate
Pigmented globules	Clonal seborrheic keratosis[22]		Compact nests of pigmented keratinocytes (Borst—Jadassohn phenomenon)
	Dermatofibroma[17]		Flattened, confluent, hyperpigmented rete ridges
	Basal cell carcinoma[20,23]		Small pigmented tumor islands
Streaks	Seborrheic keratosis[20]		Coalescence of rete ridges with pigmented basaloid cells
	Basal cell carcinoma[20,23]		Tumor cords at the periphery of the lesion
Homogenous blue	Seborrheic keratosis[20,22]		Compact areas of pigmented keratinocytes
	Radiation tattoo[20]		Ink deposited in the dermis
	Basal cell carcinoma[20,23]		Dermal pigmented tumor nests with melanocytes and melanophages

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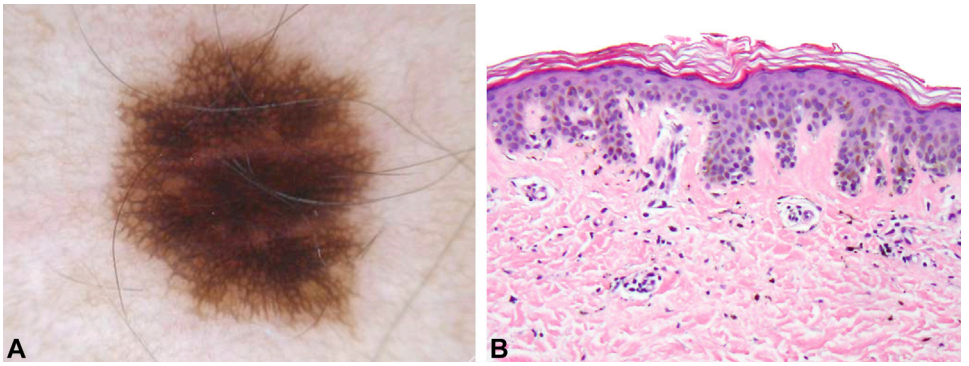


Fig 2. Junctional nevus. The presence of pigment network on dermoscopy (**A**) corresponds histologically to the presence of nevomelanocytes and pigmented keratinocytes along the dermal-epidermal junction (**B**).

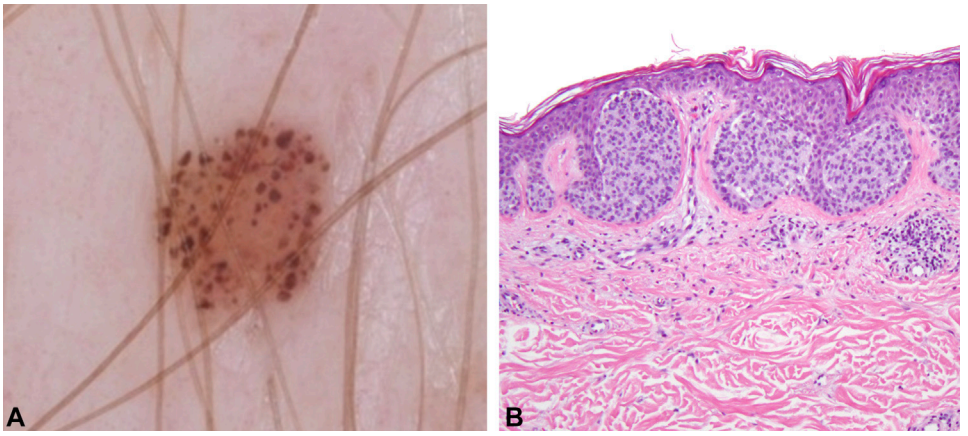


Fig 3. On dermoscopy, globules (**A**) can reveal nests of nevomelanocytes located in the dermal epidermal junction or in the dermis (**B**).

are highly specific for melanocytic neoplasms.[15,16] The description of these features and their histopathologic correlates are described below and summarized in Table I. While these structures are usually associated with melanocytic neoplasms, they can be encountered in nonmelanocytic lesions (Table II).[24]

Pigment network (lines, reticular). Pigment network corresponds to brown lines forming a reticular pattern in a grid-like arrangement.[4] Histologically, the lines correspond to increased pigmentation along elongated rete ridges because of an increased density of melanocytes and pigmented keratinocytes per unit area.[25] Conversely, the lighter "holes" among the pigmented lines correspond to the suprapapillary plates (Fig 2).[25] Regular pigment network is common in melanocytic nevi but can also be seen in nonmelanocytic lesions, such as dermatofibromas or accessory nipples (Table II).[17,20] Atypical pigment network lines varying in size, color, thickness, or distribution are more commonly found in dysplastic nevi and superficial spreading melanoma.[4] Histologically, atypical pigment network reveals disarrangement of the rete ridges with pleomorphic melanocytes and changes in melanin distribution within the epithelium.[26]

Negative network (lines, reticular, hypopigmented, around brown clods). Negative network consists of serpiginous hypopigmented lines that surround hyperpigmented, elongated-to-curvilinear globular structures.[27] One study suggested that the negative network corresponds to hypopigmented elongated rete ridges bridging and surrounding large nests of melanocytes within the dermal papillae.[6] However, another study could not corroborate these findings.[27] Negative network occurs in Spitz nevi and in melanomas,[28] specifically melanomas arising in nevi (Fig 1).[29,30]

Angulated lines (lines, angulated or polygonal). Angulated lines are linear lines forming a zigzag pattern. These lines can coalesce into polygons with the most common being a rhomboid. When present in the face, these structures are called rhomboidal structures[4] and are highly

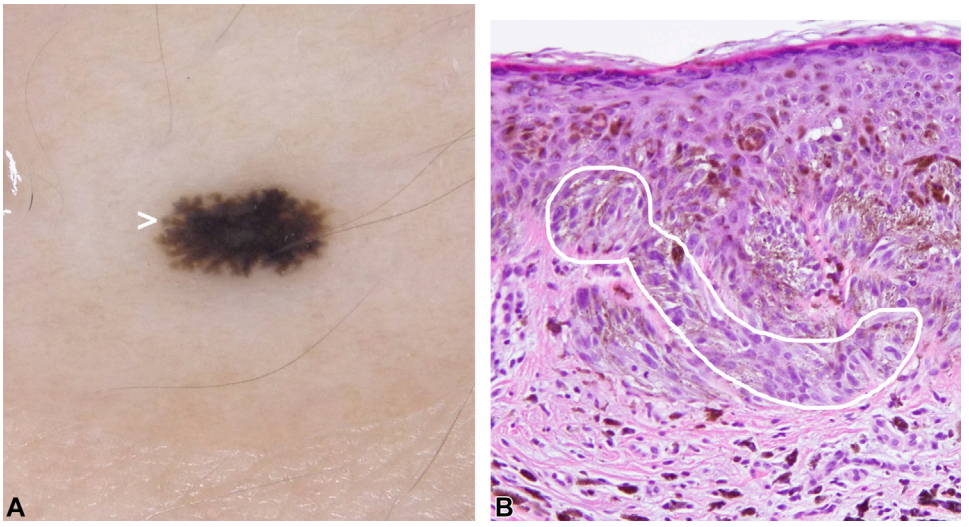


Fig 4. Reed nevus. **A**, Dermoscopically the lesion presented with a regular starburst pattern presenting with pseudopods (arrowhead). **B**, Histologically, pseudopods corresponds to confluent nests of melanocytes at the periphery.

suggestive of lentigo maligna.[31,32] Outside the face they are called polygons and are suggestive of lentiginous melanomas of chronically sun-exposed skin.[33] Histologically, angulated lines correspond to a flattened DEJ with fewer and more attenuated rete ridges, proliferation of confluent atypical junctional melanocytes, and dermal melanophages.[34] However, it remains elusive as to why these structures occur in a linear, zigzag, polygonal fashion. We speculate that this may somehow be related to skin markings but have no direct evidence for this yet.

Globules (clods, small, round or oval). Globules are round to oval, usually brown to black structures that are found clustered together in aggregates of ≥3 or are found located along the periphery of a melanocytic lesion (Fig 3).[4,9,10] Brown and black globules correspond with melanocytic nests at the DEJ or in the papillary dermis, whereas blue globules represent deeper nests located in the reticular dermis.[7] Globules distributed along the perimeter of a melanocytic neoplasm correspond with the lesion's radial growth phase.[4,7] Irregular globules with increased variability in their sizes, shapes, or colors should raise suspicion for melanoma.[4] Occasionally, one can see white globules that correspond with melanocytic nests displaying balloon cell changes.[11] Irregular globules distributed eccentrically at the periphery of a pink to tan papulo-nodule should raise the suspicion for BAP1-inactivated melanocytic tumors.[35]

Streaks (lines, radial—always at the periphery). Streaks, encompassing radial streaming and pseudopods, are radial projections that are located at the periphery of the lesion. These projections emanate from the tumor and project toward normal skin. In radial streaming the projections are linear, whereas in pseudopods the projections have small terminal knobs. While there may be differences in the rate of growth of tumors with radial streaming versus pseudopods, both structures correspond on histopathology to confluent junctional nests of pigmented melanocytes at the periphery (Fig 4).[25] When streaks are located symmetrically around the entire lesion, they favor a Reed nevus. Conversely, if the streaks are located asymmetrically they favor a superficial spreading melanoma.[36]

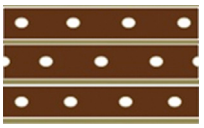
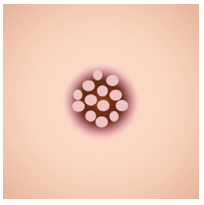
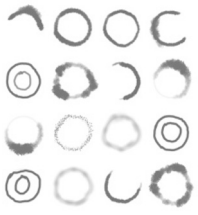
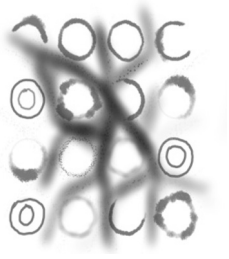
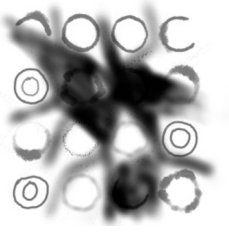
Homogenous blue pattern (structureless blue). Homogenous blue pattern is a structureless pattern that is characterized only by the presence of blue throughout the lesion.[4] This pattern reveals a dermal population of densely pigmented melanocytes and can be seen in blue nevi, combined nevi, pigmented nodular melanoma, and primary or metastatic melanoma.[7] Therefore, when evaluating a homogenous blue lesion, the clinical history is paramount; a stable, longstanding lesion favors a blue nevus, whereas a new lesion in a patient with a history of melanoma should raise the concern for metastatic melanoma.

Dermoscopic structures present in melanocytic neoplasms located in special sites

In volar, facial, mucosal, and nail lesions, unique microanatomy produces different dermoscopic patterns. Descriptions of the dermoscopic features and their histopathologic correlates are described below and summarized in Table III.

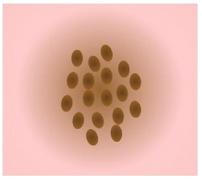
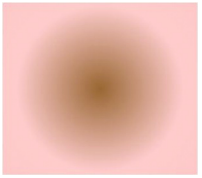
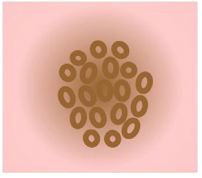
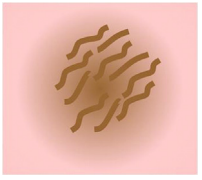
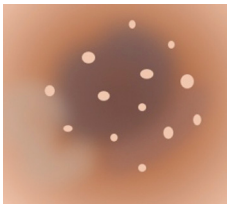
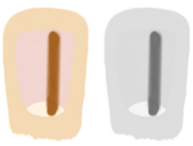
Volar skin. In palmoplantar skin, melanin tends to be located mainly in the furrows or the ridges of

Table III. Dermoscopic structures present in melanocytic neoplasms located in special sites

	Schematic illustration	Metaphorical term	Descriptive term	Histopathologic correlate	Clinical association
Volar skin		Parallel furrow pattern	Lines, parallel, thin, in the furrows	Pigmented keratinocytes and melanocytes in the furrows (crista limitants)	Acral nevus
		Parallel ridge pattern	Lines, parallel, thick, on the ridges	Melanocytes in the rete ridges associated with the acrosyringia (crista intermedia)	Acral melanoma
Face		Pseudonetwork	Structureless, brown, interrupted by follicular openings	Pigmented cells in the epidermis and the dermal-epidermal junction interrupted by follicular openings	Facial nevus
		Concentric circles (circles within circles)	Circles, concentric; the pigmented ring can be seen within and surrounding the adnexal opening	Junctional proliferation of atypical melanocytes along the dermal-epidermal junction with varying degrees of follicular and dermal invasion	Lentigo maligna
		Grey circles	Circles, gray; small gray rings within follicular openings		
		Asymmetric pigmented follicular openings	Circles, incomplete; pigment rings that do not uniformly surround an adnexal opening		
		Rhomboids/zig zag pattern	Lines, angulated or polygonal, surrounding adnexal openings		
		Blotches with obliteration of follicles	Structureless zone, brown black, with loss of visible adnexal openings		

Continued

Table III. Cont'd

	Schematic illustration	Metaphorical term	Descriptive term	Histopathologic correlate	Clinical association
Mucosa		Dotted/globular patterns	Dots or clods, round or oval, brown	Aggregates of melanin in the upper lamina propria	Mucosal nevus, mucosal melanosis
		Homogenous pattern	Structureless area, brown	Flattened rete ridges and acanthosis	
		Ring-like pattern	Circles, or half-circles, brown	Hyperpigmented epithelial cells and broadened rete ridges which skip the papillae	
		Fish scale–like pattern (variant of ring-like pattern)			
		Parallel, reticular-like or hyphal pattern	Lines, slightly angulated, brown	Hyperpigmentation of the tip of the rete ridges which are distributed obliquely	
		Homogenous pattern with the presence of blue, gray, or white colors	Structureless areas with blue, gray, or white color	Suspicious for mucosal melanoma	Mucosal melanoma
		Regular pigmented bands	Parallel lines originating from the proximal nail fold, without variation in colors, thickness or spacing	Most likely reveals a benign condition in the nail matrix	Brown: nevus; gray: lentigo

Continued

Table III. Cont'd

	Schematic illustration	Metaphorical term	Descriptive term	Histopathologic correlate	Clinical association
Nails		Irregular pigmented bands	Lines origination from the proximal nail fold showing multiple colors (black, brown, gray), variation in the thickness and spacing of lines, and loss of parallelism	Most likely reveals a melanoma in the nail matrix	Nail matrix melanoma

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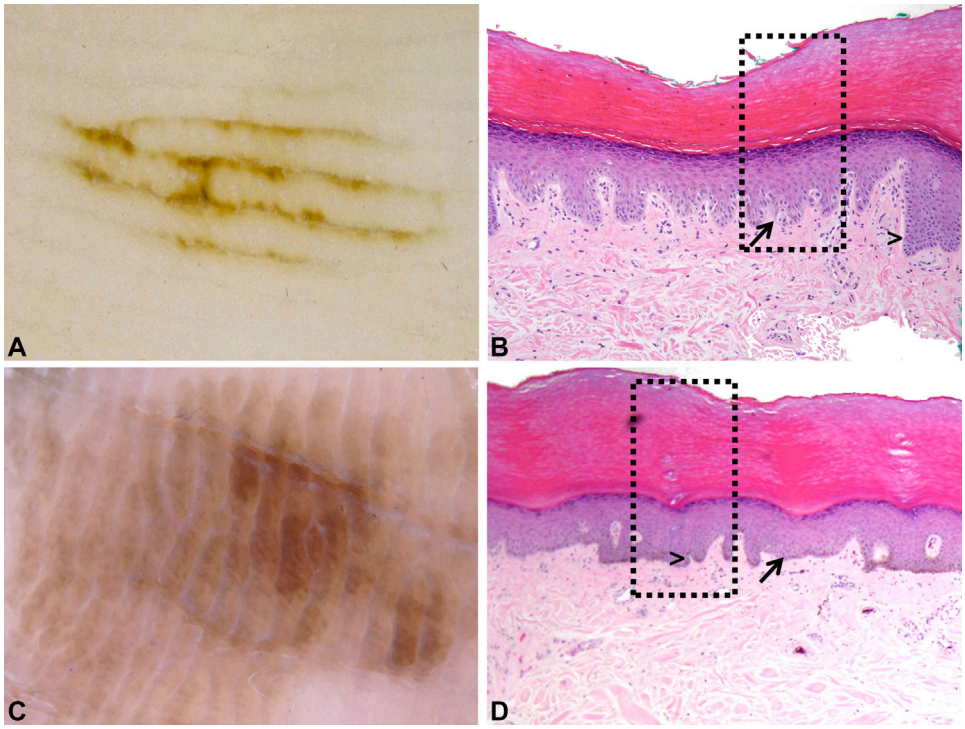


Fig 5. Melanocytic lesions located in volar skin. **A**, Dermoscopic image showing a parallel furrow pattern. **B**, The presence of a pigment in the furrows (rectangle) corresponds histologically to the presence of melanocytes in the crista limitants (arrow) and is generally indicative of a nevus. **C**, Dermoscopic image showing a parallel ridge pattern. **D**, The presence of pigment in the ridges corresponds histologically to the presence of melanocytes in the crista intermedia (arrowhead) and should raise suspicion for melanoma.

the dermatoglyphics, resulting in 2 predominant patterns: the parallel furrow pattern and the parallel ridge pattern. The former consists of pigment located in the furrows and is frequently associated with benign melanocytic lesions (Fig 5, Table III). Histologically, it results from nevomelanocytes preferably transferring pigment to keratinocytes located in the crista limitans (furrows).[37] The parallel ridge pattern consists of pigment located on the ridges and is associated mostly with melanoma (Fig 5, Table III). It has been shown that malignant melanocytes tend to be more abundant around the rete ridges associated with the acrosyringia (crista intermedia).[37] Some have hypothesized that melanoma arises from stem cells residing around the acrosyringium and have further speculated that the

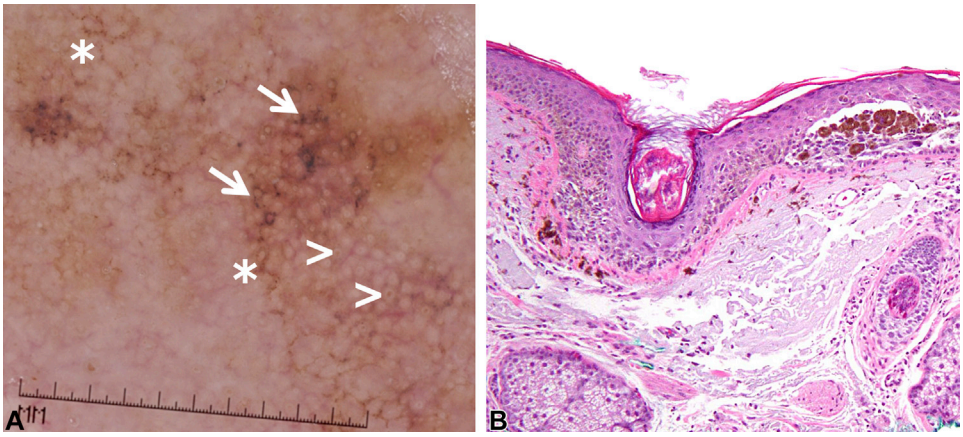


Fig 6. Lentigo maligna. **A**, On dermoscopy, this lesion presents with concentric circles (arrowheads), asymmetric pigmented follicular openings (arrows) and angulated lines (asterisk). **B**, Histologically, the presence of these findings correlates with proliferation of atypical melanocytes along the dermoepidermal junction with follicular involvement.

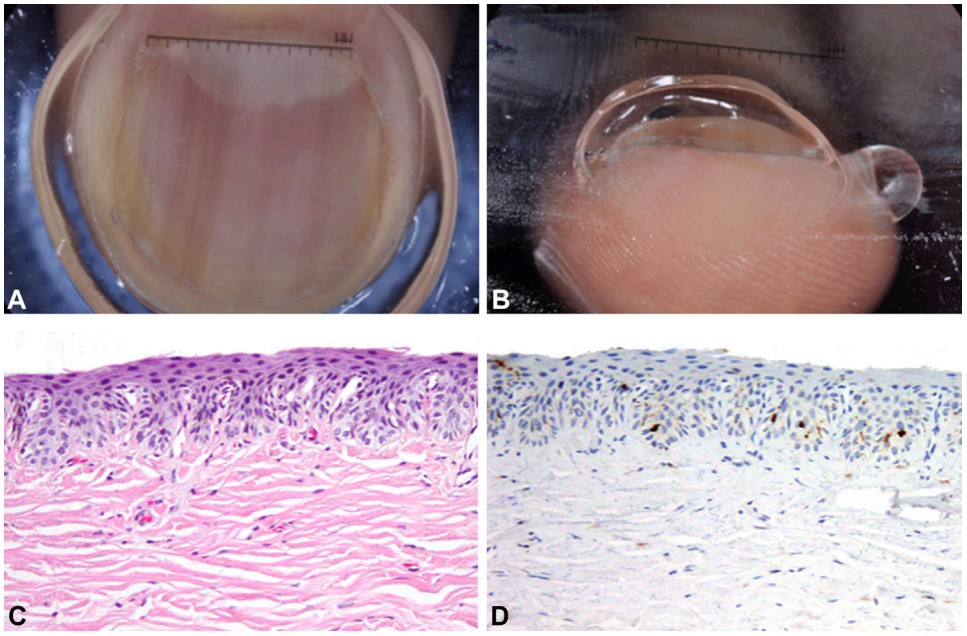
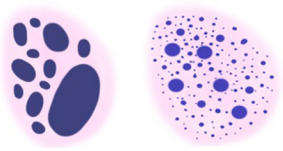
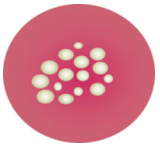
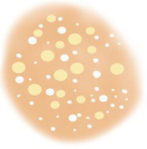


Fig 7. Subungual melanoma. **A**, Dermoscopic image showing a pigmented band revealing irregular lines along the nail plate. **B**, Free-edge dermoscopy showing pigment predominantly in the lower portion of the nail plate, suggesting that the melanocytic lesion is located in the distal nail matrix. **C** and **D**, Histologic results of the nail matrix confirmed the presence of a melanoma.

microenvironment associated with the crista intermedia may be more conducive to the proliferation of these malignant cells.[38]

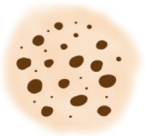
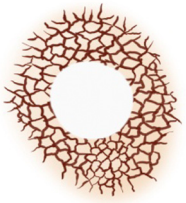
Facial skin. The microanatomy of facial skin usually reveals a flattened DEJ interrupted by numerous adnexal openings. Because of the flattened DEJ, the reticular pattern is not common on the face. Instead, pigmented lesions on the face often have a more homogeneous appearance that is interrupted by adnexal openings, leading to a pseudonetwork pattern. In other words, the pseudonetwork pattern corresponds to a brown structureless area that is interrupted by follicular openings, which in combination leads to a pattern reminiscent of a network.[4] Histologically, it corresponds to pigmented cells located in the epidermis and DEJ interrupted by follicular openings.[6,31] Several dermoscopic features that disrupt the pseudonetwork have been associated with lentigo maligna. The most relevant are blotches with obliteration of the follicles, concentric circles (or circles within circles), gray circles, asymmetric follicular

Table IV. Dermoscopic structures with high specificity for nonmelanocytic neoplasms

Clinical association	Schematic illustration	Dermoscopic structures	Definition	Histopathologic correlation
BCC		Blue-gray ovoid nests, multiple blue-gray globules and dots	Clods, dots, blue/gray, not aggregated	Large (ovoid nests) or small (globules) basal cell carcinoma nodules in the dermis; dots are small BCC nests at the DEJ or in superficial dermis
		Leaflike areas	Lines, radial, connected to a common base	Pigmented BCC nests connected to each other at the DEJ
		Spoke wheel areas, concentric structures	Spoke wheel areas: lines, radial, converging to a central dot or clod; concentric structures: clod within a clod	Pigmented BCC nests and cords connecting to each other at the DEJ
Actinic keratosis		Strawberry pattern	Structureless, red, interrupted by follicular openings	Localized increase of vasculature and follicular hyperkeratosis
SCC		White circles	Bright white circles surrounding a dilated infundibulum	Acanthosis and hypergranulosis of the infundibular epidermis
Bowen disease		Linear dark dots/globules	Dots, clods, peripheral, arranged in lines	Atypical clusters of basal pigmented keratinocytes
Seborrheic keratosis		Milia-like cysts	Dots or clods, white, clustered or disseminated	Intraepidermal keratin cysts

Continued

Table IV. Cont'd

Clinical association	Schematic illustration	Dermoscopic structures	Definition	Histopathologic correlation
		Comedo-like openings/ crypts	Clods, brown, yellow, or orange, rarely black	Epidermal invaginations filled with keratin
Dermatofibroma		Central white patch	Structureless zone, white, central	Prominent fibrosis in the papillary dermis

BCC, Basal cell carcinoma; *DEJ*, dermoepidermal junction; *SCC*, squamous cell carcinoma.
Reprinted with permission from dermoscopedia contributors — Ralph Braun, Katrin Kerl. Dermoscopic structures. dermoscopedia. October 24, 2018, 20:20 UTC. Available at: https://dermoscopedia.org/w/index.php?title=Dermoscopic_structures&oldid=14004. Accessed October 27, 2018.

openings (incomplete circles), and rhomboidal structures (Fig 6, Table III).[31,39,40] These structures represent a proliferation of atypical melanocytes along the DEJ with varying degrees of follicular and dermal invasion.[6,31,41] Gray circles can also be seen in pigmented actinic keratosis (AK) and generally present as gray to beige homogeneous areas surrounding the hair follicle but sparing the follicular opening.[42]

Mucosal sites. The mucosal sites include the glabrous portion of the lips, the mucosal aspect of the lips, and the glabrous portion of the male and female genitalia. Few studies are available to correlate the histology of dermoscopic structures seen on mucosal sites. Clinical examination of mucosal lesions with the naked eye can be challenging because both benign melanocytic lesions and early melanoma often manifest an atypical morphology.[43,44]

Four dermoscopic structures can be seen in benign mucosal melanocytic lesions: dots/globules, structureless areas, circles including half circles (the fish scale pattern), and lines. These structures are not discussed in the 2016 IDS consensus paper because mucosal sites were not evaluated in the consensus. The dotted globular pattern presents with multiple dots/globules of similar sizes and shapes and corresponds to aggregates of melanin in the upper lamina propria.[45] A homogenous pattern consists of structureless areas on dermoscopy and corresponds to flattened rete ridges along with acanthosis.[45] A ring-like pattern consists of brown pigmented circles, while a fish scale–like pattern contains brown half circles. Circles/half circles in the mucosae correspond to hyperpigmented epithelial cells located along broadened rete ridges, which skip the papillae.[45,46] A hyphal pattern consists of lines resembling fungal hyphae. Histologically, lines correspond to hyperpigmentation of the tip of the rete ridges, which are oriented obliquely.[45] Lines can also adopt a parallel- or reticular-like appearance.[46,47]

Dermoscopically, mucosal melanomas usually reveal multiple colors and dermoscopic structures that are distributed in a disorganized manner.[48] Mucosal melanomas can also contain dermoscopic features that are normally associated with cutaneous melanomas of nonspecial sites, such as regression structures or a blue-whitish veil.[49] To date, the best diagnostic model to differentiate benign melanocytic lesions from melanoma found that lesions with structureless areas in addition to blue, gray, or white color was associated with 100% sensitivity and 82% specificity for mucosal melanoma.[48] However, these findings are limited by the fact that most mucosal melanomas in the study were advanced lesions. Several case reports have shown that early mucosal melanomas may not show these features.[50,51]

Nail unit. The differential diagnosis for melanonychia striata or longitudinal melanonychia includes traumatism, infection, melanocytic activation (drug-

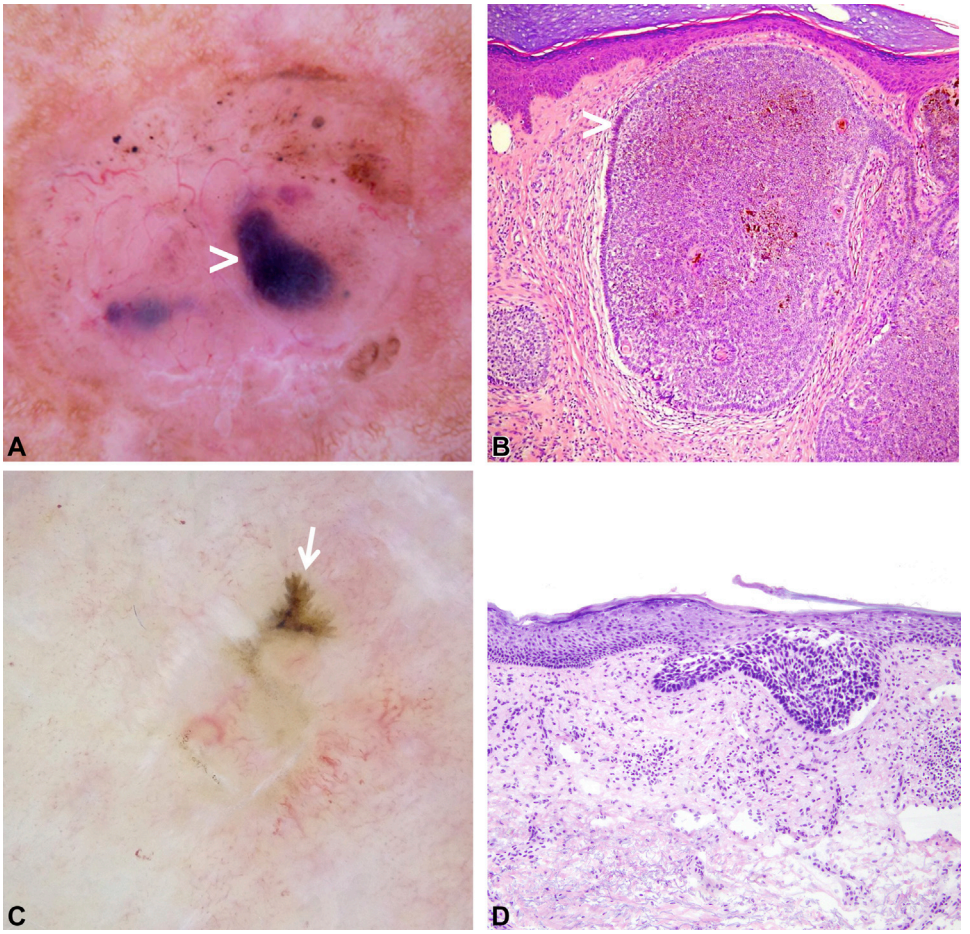


Fig 8. Basal cell carcinomas showing dermoscopic features with high specificity for basal cell carcinoma. **A**, Dermoscopic image revealing a large ovoid nest (arrowhead). **B**, Histologically, this corresponded to a large BCC dermal tumor nest. **C**, Dermoscopic image showing a leaflike structure (arrow). **D**, Histologically, this corresponded to a basal cell carcinoma tumor cord connected to the epidermis and is diagnostic of superficial basal cell carcinoma.

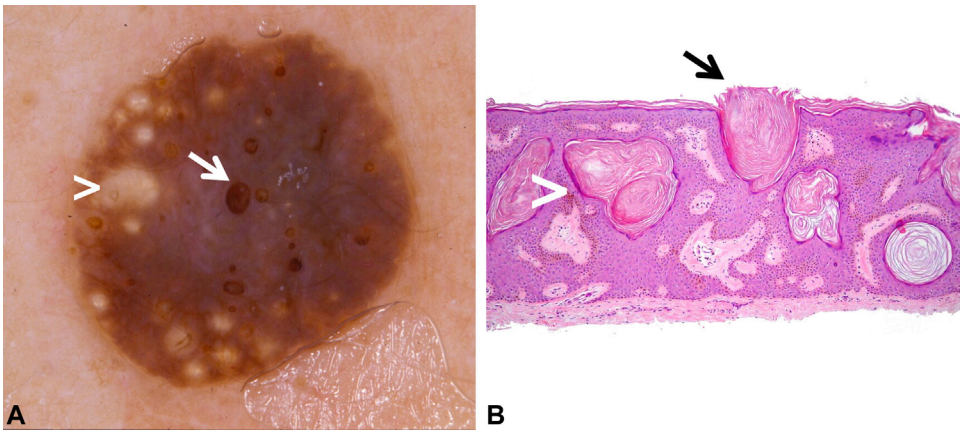
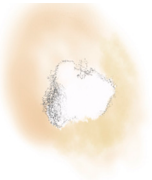


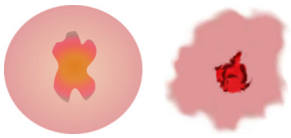
Fig 9. Seborrheic keratosis. **A**, Dermoscopic image revealing comedo-like openings (arrow) and milia-like cysts (arrowhead). **B**, The former corresponds to epidermal invaginations filled with keratin (arrow), whereas the latter corresponds to intraepidermal keratin cysts (arrowhead).

Table V. Nonspecific dermoscopic structures

Schematic illustration	Metaphorical term	Descriptive term	Histopathologic correlate	Clinical association
	Blotch	Structureless zone, brown or black	Aggregates of melanin in the stratum corneum or throughout all layers of the skin	Nevus, melanoma, seborrheic keratosis, basal cell carcinoma
	Dots	Dots, black or brown	Aggregates of melanocytes or melanin granules; if black, in papillary dermis; if brown, in reticular dermis	Nevus, basal cell carcinoma, melanoma, keratinocyte carcinomas
	Peppering/granularity and scar-like depigmentation	Peppering/granularity: dots, gray; scar-like depigmentation: structureless zone, white; often seen together	Peppering/granularity: regression with melanophages' scar-like depigmentation: fibrotic papillary dermis	Melanoma, lichen planus-like keratosis, melanocytic nevus (if focal)
	Shiny white structures (only seen with polarized dermoscopy)	Shiny white streaks: lines, white, perpendicular	Unclear; suspected increased collagen and dermal fibroplasia	Spitz nevus, dysplastic nevus, melanoma, lichen planus–like keratosis, basal cell carcinoma
		Rosettes: dots, white, 4 arranged in a square	Hyperkeratosis in the follicular openings alternating with the normal surrounding stratum corneum	Actinic keratosis, squamous cell carcinoma, melanoma
		Shiny white blotches and strands: clods, white, shiny	Unclear; suspected to be fibrosis in the underlying stroma	Basal cell carcinoma, melanoma, lichen planus–like keratosis
	Blue-whitish veil	Structureless zone, blue with a white "ground glass" haze found over a raised area that does not occupy the entire lesion	Heavily pigmented dermal melanocytes combined with compact orthokeratosis	Melanoma, Spitz/Reed nevus, seborrheic keratosis, pyogenic granuloma, basal cell carcinoma

Continued

Table V. Cont'd

Schematic illustration	Metaphorical term	Descriptive term	Histopathologic correlate	Clinical association
	Scale	Homogenous opaque yellow to brown structures	Hyperkeratosis and parakeratosis	Actinic keratosis, squamous cell carcinoma, porokeratosis, and inflammatory skin diseases
	Erosion/Ulceration	Structureless dark red to brown areas with a serous crust.	Erosion: loss of the epidermis; ulceration: loss of the epidermis and superficial dermis	Basal cell carcinoma, squamous cell carcinoma, traumatism, melanoma

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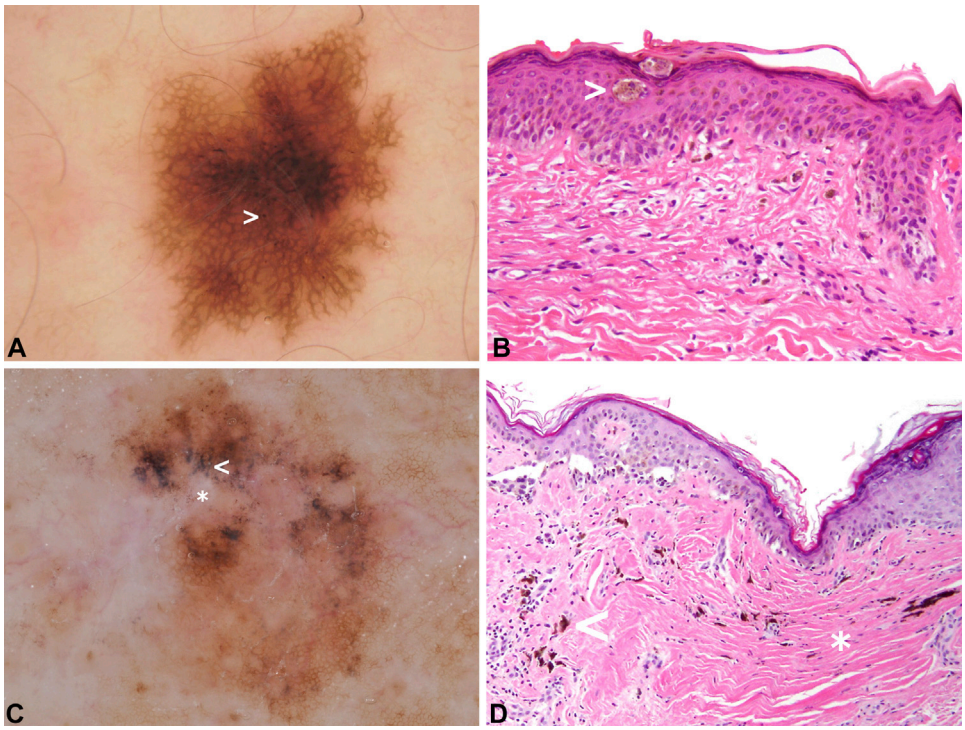


Fig 10. Examples of dots on dermoscopy and their histopathologic correlates. **A**, In this melanocytic nevus, black dots on the network correspond to small nests located in the upper epidermis (**B**). **C**, In this melanoma, blue-gray dots, also known as peppering or granularity, correspond to melanophages (arrowhead, **D**) and can be associated with scar-like depigmentation (asterisk), which corresponds to dermal fibrosis (asterisk, **D**).

induced pigmentation, lentigo, postinflammatory pigmentation) or melanocytic proliferation (nevus, melanocytic hyperplasia, or melanoma).[6,52] Dermoscopy helps distinguish between these entities and can guide the most appropriate area within the nail matrix from which to obtain a biopsy specimen (proximal vs distal). The IDS consensus statement on dermoscopic terminology did not include features that are specific to the nail unit.

Pigment granules within the pigmented nail band can help distinguish whether the melanonychia is caused by melanocyte activation or proliferation.

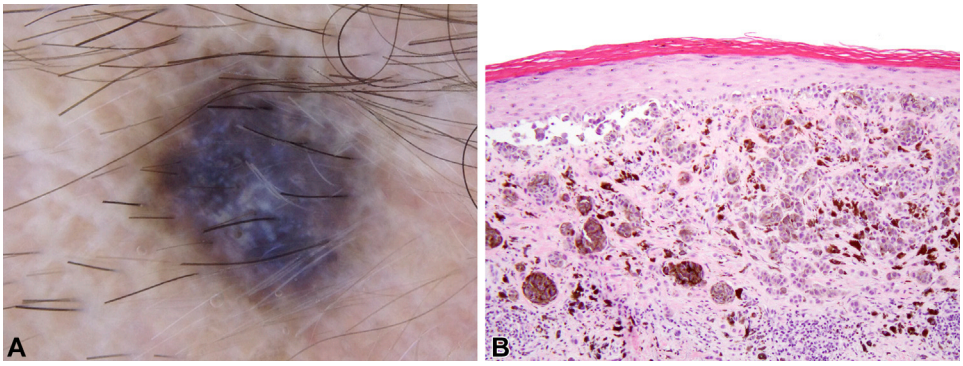
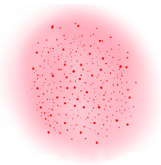


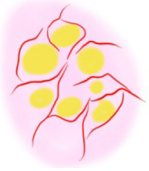
Fig 11. Invasive melanoma. **A**, Dermoscopic image showing a blue-whitish veil and shiny white streaks. **B**, The blue-whitish veil is associated with a proliferation of pigmented dermal melanocytes together with compact orthokeratosis, whereas shiny white streaks are associated with dermal fibrosis.

Table VI. Vessels identified on dermoscopy and typical clinical associations[4,6]

Schematic illustration	Metaphorical term	Descriptive term	Clinical association
	Arborizing vessels	Branched vessels, large	Basal cell carcinoma (nodular)
	Lacunae	Clods, red, purple, black	Angioma (red, purple lacunae, angiokeratoma (blue, black lacunae)
	Serpentine vessels	Linear irregular vessels	Basal cell carcinoma (superficial), melanoma, scars
	Dotted vessels	Red dots	Spitz nevus, melanoma, inflammatory conditions, stasis dermatitis
	String of pearls	Serpiginous vessel arrangement of dotted vessels	Clear cell acanthoma

Continued

Table VI. Cont'd

Schematic illustration	Metaphorical term	Descriptive term	Clinical association
	Comma vessels	Curved, short vessels	Intradermal nevus (if monomorphous), melanoma (if polymorphous)
	Hairpin vessels	Looped vessels	Seborrheic keratosis, keratinizing tumor/ keratoacanthoma, warts
	Glomerular vessels	Coiled vessels	Squamous cell carcinoma/ Bowen disease
	Crown vessels	Vessels arranged radially, do not cross the center of the lesion	Sebaceous hyperplasia
	Polymorphous vasculature	Multiple vessel morphologies	Melanoma, Merkel cell carcinoma, angiosarcoma, eccrine poromas, squamous cell carcinoma

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The absence of granules within a grayish colored band is highly suggestive of melanocytic activation (epithelial hyperpigmentation). In contrast, the bands caused by melanocytic proliferation are usually brown to black in color, have brown/black granules (melanin inclusions), and usually also have multiple prominent linear lines within the band.[53] When evaluating melanonychia caused by melanocytic proliferation, the primary objective is to differentiate nail matrix nevi from melanoma. Melanonychia revealing multiple colors, individual lines within the band displaying irregular spacing, or lines that fail to remain parallel (loss of parallelism) should raise concern for melanoma.[53] When evaluating the pigmented nail band, it is also important to examine the cuticle, hyponychium, and nail plate. The presence of pigment in the proximal nail fold (Hutchinson sign and micro-Hutchinson sign), pigmentation on the hyponychium, and nail dystrophy are associated with melanoma.[53]

Dermoscopy of the free edge of the nail plate can guide where a biopsy specimen should be obtained from the nail matrix. Melanocytic lesions located in the proximal nail matrix will reveal increased

pigment on the upper part of the free edge of the nail plate on dermoscopy. Conversely, pigment located in the lower part of the nail's free edge corresponds to a melanocytic lesion located in the distal nail matrix (Fig 7).[54]

Dermoscopic structures with high specificity for nonmelanocytic neoplasms

Several dermoscopic features are relatively specific to nonmelanocytic neoplasms, such as basal cell carcinoma (BCC), seborrheic keratosis (SK), and dermatofibroma (Table IV). The presence of one of these structures or a combination of these structures cannot only help in rendering a more accurate diagnosis but can also help in differentiating aggressive tumors from less aggressive tumors and help predict tumor subtypes. This is discussed in greater detail in the second article in this continuing medical education series.

Blue-gray ovoid nests, multiple blue-gray globules and dots (clods, dots, blue/gray). Blue-gray globules usually appear as multiple nonaggregated oval structures. Blue-gray dots usually appear as dots distributed in a random buckshot scattered pattern. Blue-gray globules correspond to small BCC tumor nests in the dermis and blue-gray dots represent small BCC aggregates at the DEJ or in superficial dermis. Ovoid nests are well-circumscribed larger blue-gray globules that correspond histologically to large BCC tumor islands in the dermis (Fig 8, *A* and *B*).[4,6,55] The blue-gray color of these BCC tumor islands is caused by melanocyte colonization and melanization of the BCC tumor islands.[56]

Leaflike areas (lines, radial, connected to a common base), and spoke wheel areas (lines, radial, converging to a central dot or clod). Leaflike areas are brown to blue-gray projections that are connected radially at a common base, resulting in structures that resemble the shape of leaves (Fig 8, *C* and *D*).[4] A variant of the leaflike structure is the spoke wheel area, which consists of radial projections that are connected at a common central darker base. At times the radial projections are poorly defined, resulting in globular structures displaying a central dark hub (concentric structures). Histologically, all of these structures correspond to pigmented BCC nests at the DEJ and in the superficial papillary dermis.[6,55] In the absence of pigment network, the presence of any of these structures is diagnostic for BCC.[57]

Strawberry pattern (structureless, red, interrupted by follicular openings). The strawberry pattern consists of an erythematous pseudonetwork interrupted by keratin-filled follicular openings (Table IV).[4,58] This pattern is characteristic of nonpigmented AK.[58] Histologically, this reveals partial thickness keratinocyte atypia, keratin in follicular ostia, and an increase in vasculature.

White circles. White circles are bright white circles surrounding an orange/yellow keratin plug (Table IV).[59] Histologically, they correspond to acanthosis and hypergranulosis of the infundibular epidermis. White circles are associated with well-differentiated squamous cell carcinoma (SCC) and keratoacanthomas.[59]

Dark dots/globules or round circles in linear arrangement (dots, clods, peripheral, arranged in lines). Pigmented SCC in situ often reveals brown to gray oval to round circular structures. These structures are often distributed linearly. Histologically, they represent clusters of atypical basal pigmented keratinocytes.[60]

Milia-like cysts (dots or clods, white, clustered or disseminated). Milia-like cysts are white to yellow round structures that shine brightly[4] under nonpolarized dermoscopy. Toggling between the polarized and nonpolarized light causes these structures to "blink."[61] Histologically, they correspond to intraepidermal keratin cysts (Fig 9).[4,6,62] Multiple milia-like cysts are typical of SKs but can also be seen in melanocytic nevi, melanomas, and BCCs.[62]

Comedo-like openings and crypts (clods, brown, yellow, or orange, rarely black). Comedo-like openings are round to oval, brown to black epidermal invagination. When the invagination is larger and more elongated, it is called a crypt.[4] Histologically, they correspond to epidermal invaginations filled with keratin (Fig 9).[6,62] They are typically seen in SKs but can also be present in papillomatous lesions, such as intradermal nevi.

Central white patch (structureless zone, white, central). Central white patch is a white structureless area located in the center of a lesion (Table IV).[4] A central white patch in combination with a peripheral network is characteristic of dermatofibromas. Histopathologically, this feature corresponds to fibrosis in the papillary dermis.[17]

Nonspecific dermoscopic structures

Several dermoscopic features are seen in melanocytic and nonmelanocytic lesions. The description of these features and their histopathologic correlates is described below and summarized in Table V.

Dots (dots, any color). Dots are round structures that are similar to, but smaller than, globules. Their size is about the size of the diameter of a terminal hair follicle.[4] Brown, black, gray, and blue dots are most common in cutaneous neoplasms.[6,9] Black dots correlate with pigment in the superficial

epidermis or in the stratum corneum, and occur frequently in small, heavily pigmented compound or junctional nevi (Fig 10, *A* and *B*). Brown dots correlate with small melanocytic nests in the epidermis or in the DEJ. Blue-gray dots correspond to free pigment in the papillary dermis or inside dermal melanophages (the equivalent to peppering, see below) (Fig 10, *C* and *D*). Blue-gray dots correspond to small BCC tumor nests. Red dots are equivalent to dotted vessels and can be present in multiples entities, such as Spitz nevi, keratinocyte carcinomas, and melanomas.[16,25,63]

Blotches (structureless zone, brown or black). Blotches are dark brown to black structureless areas that obscure the ability to see any underlying structures.[4,9] A regular, centrally located blotch can be found in melanocytic nevi. However, blotches that appear in multiples or that are off-centered are considered irregular and increase the suspicion for melanoma.[4,64] Histologically, they represent hyperpigmentation with abundant melanin throughout the epidermis, with or without presence of pigment in the underlying dermis.[63] Sometimes, blotches are caused by a heavy concentration of melanin in the stratum corneum, as can occur after an intense burst of ultraviolet exposure. When melanin is confined to the stratum corneum it is called a lamella,[65] which can be stripped off with a piece of tape, thereby allowing the observer to see the underlying dermoscopic structures.[66] Blotches can also be seen in SKs and BCCs.

Granularity/peppering (dots, gray) and scar-like depigmentation (structureless zone, white). These 2 structures correspond with histologic regression. They can occur together or independent of each other.[4] Peppering or granularity appears as fine blue-gray dots on dermoscopy. They correspond to free melanin in the dermis or inside melanophages. Peppering can be seen in melanomas, in lichen planus–like keratoses (LPLKs),[4] and focally in melanocytic nevi.[67] Scar-like areas are porcelain-white structureless areas lacking shiny white structures or vessels and are lighter in color than perilesional skin.[4] Histologically, these areas contain dermal fibroplasia (Fig 10, *C* and *D*)[25] and therefore are not optimal areas for step sectioning when grossing a suspected melanoma because they may reveal fibrosis and may lead to tumor thickness underestimation.

Shiny white structures (lines, dots, clods, white and shiny). Shiny white structures are only seen with polarized dermoscopy and encompass shiny white streaks, blotches, strands, and rosettes.

Shiny white streaks. Shiny white streaks are short white lines that are often oriented orthogonally to each other.[4,68] Histopathologically they correspond to altered dermal collagen resulting from stromal alterations (Fig 11).[27,69] They are only visible with polarized dermoscopy and may require the operator to rotate the dermoscope over the lesion as the birefringent properties depend on the angle of the collagen (angular dependence). Shiny white streaks are associated with Spitz nevi, atypical nevi, melanomas, LPLKs, and BCCs.[68-71]

Rosettes. Rosettes present as 4 round bright white dots arranged in a 4-leaf clover pattern. Rosettes occur in sun-damaged skin and have been described in AKs, SCCs, and rarely in melanomas.[72-75] Histologically, they correspond with hyperkeratosis of the follicular openings.[74,75]

Shiny white blotches and strands. Shiny white blotches and strands are small to large white homogenous to linear areas. The white blotches can vary in size and shape. The strands tend to be long linear white areas. These linear strands are often arranged parallel to each other and they rarely intersect.[23] These structures are common in BCCs and are rarely found in melanomas and LPLKs.[23,74] Although shiny white blotches and strands are thought to correspond to fibrosis of underlying stroma, the exact histopathologic correlate remains to be elucidated.

Blue-whitish veil (structureless zone, blue). Blue-whitish veils occur in raised/palpable areas of a lesion and appear as irregular bluish blotches with overlying white ground-glass haze, occupying only part of the lesion.[9,36] A blue-whitish veil should raise concern for melanoma, but can also be seen in Reed nevi, Spitz nevi, and nonmelanocytic lesions, such as pyogenic granuloma, BCCs, and SKs.[36,76,77] In melanocytic neoplasms, it represents heavily pigmented melanocytes and/or melanophages in the dermis with acanthosis and compact orthokeratosis (Fig 11).[9,25,78]

Scale. Common terms, such as scale or erosions, were not included in the 2016 dermoscopy terminology consensus because they are clinically identifiable without dermoscopy. Scale is common in AKs, SCC, porokeratosis, and inflammatory skin diseases. They correspond to homogenous opaque yellow to brown structures and histologically correspond to hyperkeratosis and parakeratosis.[79,80]

Erosions and ulcerations. Erosions are small brown-red to orange-yellow crusts that histologically reveal epidermal loss.[55] Multiple small erosions are suggestive of superficial BCC, but can also occur in SCC and after trauma.[81] Ulcerations are larger red-to-orange structureless areas with loss of the entire epidermis to the depth of the papillary dermis. A single ulceration is characteristic of nodular BCC but can also be seen in melanoma, SCC, and after trauma.[55]

Vessels

While certain vessel morphologies are associated with specific disease entities (Table VI), there are no observable direct histopathology correlates for these vessels visible on routine step sections and therefore they are not detailed in this review. The morphology of the vessel seen with dermoscopy depends on the thickness of the lesion. For example, in flat lesions, the vessels are seen as red dots on dermoscopy, whereas in raised lesions the vessels can adopt a looped morphology resulting in comma or hairpin vessels.[6,82]

CONCLUSION

In conclusion, the first article in this continuing medical education series highlights the dermoscopic features for which histopathologic correlates exist. Understanding and appreciating these correlates can improve a clinician's diagnostic accuracy and can guide the clinician in selecting the most appropriate area from which to obtain a biopsy specimen. In addition, appreciating these correlates can also help inform pathologists and aid dermatopathologists in deciding the most appropriate areas within the lesion to section.

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