Dermoscopy for the Family Physician

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Noninvasive in vivo imaging techniques have become an important diagnostic aid for skin cancer detection. Dermoscopy, also known as dermatoscopy, epiluminescence microscopy, incident light microscopy, or skin surface microscopy, has been shown to increase the clinician's diagnostic accuracy when evaluating cutaneous neoplasms. A handheld instrument called a dermatoscope or dermoscope, which has a transilluminating light source and standard magnifying optics, is used to perform dermoscopy. The dermatoscope facilitates the visualization of subsurface skin structures that are not visible to the unaided eye. The main purpose for using dermoscopy is to help correctly identify lesions that have a high likelihood of being malignant (i.e., melanoma or basal cell carcinoma) and to assist in differentiating them from benign lesions clinically mimicking these cancers. Colors and structures visible with dermoscopy are required for generating a correct diagnosis. Routinely using dermoscopy and recognizing the presence of atypical pigment network, blue-white color, and dermoscopic asymmetry will likely improve the observer's sensitivity for detecting pigmented basal cell carcinoma and melanoma. A two-step algorithm based on a seven-level criterion ladder is the foundation for dermoscopic evaluation of skin lesions. The first step of the algorithm is intended to help physicians differentiate melanocytic lesions from the following nonmelanocytic lesions: dermatofibroma, basal cell carcinoma, seborrheic keratosis, and hemangioma. The second step is intended to help physicians differentiate nevi from melanoma using one of several scoring systems. From a management perspective, the two-step algorithm is intended to guide the decision-making process on whether to perform a biopsy, or to refer or reassure the patient. (*Am Fam Physician.* 2013;88(7):441-450. Copyright © 2013 American Academy of Family Physicians.)

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▶ See Editor's Note on page 448.

CME This clinical content conforms to AAFP criteria for continuing medical education (CME). See CME Quiz on page 429.

Author disclosure: Dr. Marghoob reports receiving dermoscope prototypes for testing from the four major manufacturers of this device; receiving honoraria for speaking on the topic of dermoscopy; and participating in Institutional Review Board–approved research projects funded by the National Institutes of Health and Melanoma Research Alliance, some of which partnered with companies that produce dermoscopes. Drs. Usatine and Jaimes report no financial affiliations.

Noninvasive in vivo imaging techniques have become an important diagnostic aid for skin cancer detection. Dermoscopy, also known as dermatoscopy, epiluminescence microscopy, incident light microscopy, or skin surface microscopy, is performed using a handheld instrument called a dermatoscope or dermoscope, which has a transilluminating light source and standard magnifying optics (10×). The dermatoscope facilitates visualization of subsurface skin structures located within the epidermis, dermoepidermal junction, and papillary dermis, which are otherwise not visible to the unaided eye.[1,2]

Traditionally, dermoscopy has been taught to and used by dermatologists; however, it is gaining popularity in other fields of medicine, including primary care.[3-5] Because many patients are seen routinely in the primary care setting, family physicians play an important role in screening for skin cancer and early detection of skin cancer. Dermoscopy has been shown to improve diagnostic accuracy, sensitivity, and specificity for skin cancer diagnosis by dermatologists.[6] Once thought to be a subspecialist tool, the literature has shown that family physicians can also improve their diagnostic accuracy and triage ability by using dermoscopy.[3-5,7-11]

Techniques

During naked eye examinations of the skin, much of the light transmitted toward the skin is reflected off the stratum corneum, thus precluding the observer from seeing structures located below this layer. Dermatoscopes illuminate the skin via the use of light-emitting diode bulbs, with or without the use of polarizing filters. Dermatoscopes using nonpolarized light require direct contact between the skin and the scope, and require a liquid interface, such as ultrasound gel or alcohol, to be placed between the skin and glass plate of the dermatoscope.[12]

Once the liquid interface has been applied to the skin, the scope can be placed on top of the lesion and gently pressed against the skin; it is imperative that enough pressure be applied to eliminate air bubbles. The

liquid interface prevents light from being reflected off the stratum corneum and improves refraction, thereby allowing the visualization of structures below the stratum corneum. Dermatoscopes equipped with cross-polarized filters obviate the need for direct skin contact and a liquid interface.[13] Cross-polarized filters eliminate the glare off the skin surface and increase light refraction, allowing the observer to visualize deeper skin structures.

Three types of dermoscopic techniques are currently used: (1) classic or standard contact; (2) polarized contact; and (3) polarized noncontact *(Table 1[2,13])*. Studies have demonstrated that polarized and nonpolarized dermoscopy provide complementary information.[14,15] Polarized dermoscopy may have a higher sensitivity for detecting skin cancer based on its ability to enhance the visualization of vascular and crystalline structures, both of which are commonly seen in skin cancer[15,16] *(Figure 1)*. Nonpolarized dermoscopy improves specificity because it permits easier visualization of other structures commonly seen in benign lesions, such as milia-like cysts in seborrheic keratosis.

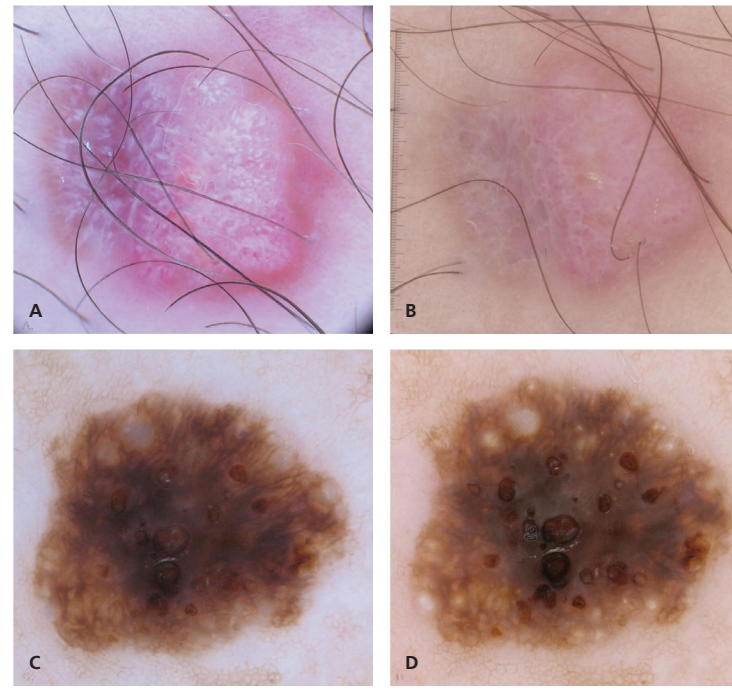


Figure 1. Amelanotic melanoma seen with *(A)* polarized and *(B)* nonpolarized dermoscopy. The crystalline structures, consisting of white shiny streaks, are only visible with polarized dermoscopy. Seborrheic keratosis seen with *(C)* polarized and *(D)* nonpolarized dermoscopy. The milia-like cysts are more conspicuous with nonpolarized dermoscopy.

Table 1. Differences Between Polarized and Nonpolarized Dermoscopy

	Nonpolarized	*Polarized*
Factor	*Classic contact dermoscopy*	*Contact and noncontact dermoscopy*
Technique	Requires a liquid interface and direct contact between the scope and the skin	Although it can be used in contact or noncontact mode, and can be used with or without a liquid interface, direct contact and liquid interface provide superior image clarity
Skin layers	Superficial layers are better visualized	Deep layers of epidermis and papillary dermis (depth of polarized light approximately 60 to 100 µm) are better visualized
Colors and structures	Blue-white veil due to orthokeratosis is more conspicuous	Pink and red colors are more conspicuous
	Milia-like cysts and comedo-like openings are more conspicuous	Milia-like cysts and comedo-like openings are less conspicuous
	Steel blue color in blue nevi appears more homogeneous	Blue color in blue nevi will appear darker, with differing hues
	Regression structures (peppering, blue-white areas, and gray color) are more conspicuous	White scar-like areas are more conspicuous
	Ability to visualize vascular structures depends on the amount of pressure applied to the skin	Vascular structures and collagen are more conspicuous
	White shiny structures cannot be visualized adequately	White shiny streaks, also known as crystalline structures, are more conspicuous

Information from references 2 and 13.

Table 2. Indications for Dermoscopy

Aid in the decision-making process as to whether to perform a biopsy; this is considered to be the most important function[19]
Evaluation of amelanotic lesions; this is feasible because of the ability to evaluate the morphology, distribution, and arrangement of blood vessels and white shiny structures[16] (Figure 1)
Evaluation of pigmented and nonpigmented skin lesions; in particular, it helps differentiate melanoma and basal cell carcinoma from benign skin lesions[6,20]

Information from references 6, 16, 19, and 20.

Clinical Impact

Dermoscopy can enhance a clinician's ability to detect skin cancer. However, improvement in diagnostic accuracy is contingent on acquiring dermoscopy training. Without formal training, the use of dermoscopy may result in poorer performance compared with naked eye examination.[17] Primary care physicians trained in dermoscopy can reduce their referral rate or benign-to-malignant excision ratio (from 9.5 to 3.5).[5] In addition, primary care physicians trained in dermoscopy improve their ability to identify skin lesions suggestive of skin cancer compared with naked eye examination alone (76% to 79% vs. 54%).[3,4] In other words, in primary care, dermoscopy improves sensitivity for the diagnosis of melanoma and improves the ability to recognize suspicious lesions that require biopsy, without significantly changing specificity (71%).[3-5] Dermoscopy also has been shown to improve the diagnostic accuracy for nonmelanocytic lesions, such as basal cell carcinoma.[18] The indications for dermoscopy are listed in *Table 2*,[6,16,19,20] and the advantages and limitations are listed in *Table 3*.[3,6,14,20-32]

Essentials of Dermoscopy: Colors and Structures

The visualization of structures within the epidermis and papillary dermis using dermoscopy has generated new terminology and clinical criteria for cutaneous lesions.[33] It is imperative that physicians using dermoscopy learn and become proficient at identifying the colors and structures, because they are required in generating a correct diagnosis.

Colors visible under dermoscopy depend on the quantity and location of keratin, blood, collagen, and melanin. Accordingly, colors visualized include yellow, red, and white for keratin, blood, and collagen, respectively. Colors for melanin range from black and brown to gray and blue, depending on the location of melanin, in terms of depth, within the skin layers.[34]

Structures visible under dermoscopy have histopathologic correlates *(Online Appendix)*. The presence of specific structures permits the classification of a lesion as a melanocytic tumor (i.e., melanocytic nevus or melanoma). Common structures visualized in melanocytic lesions are provided in *Table 4*[21,22,35-39] and *Figure 2*. When a lesion has been determined to be melanocytic, the next step is to determine if it is a nevus or a melanoma. Melanocytic nevi tend to manifest one of the symmetric patterns depicted in *Figure 3*, and melanomas reveal at least one of the 10 melanoma-specific structures provided in *Table 5*.

Nonmelanocytic lesions, including basal cell carcinoma, seborrheic keratosis, hemangioma, and angiokeratoma, also demonstrate specific structures under dermoscopy. Pigmented and nonpigmented basal cell

Table 3. Advantages and Limitations of Dermoscopy

Advantages
Aids in diagnosis and differentiation of tumoral pathologies (i.e., basal cell carcinoma, dermatofibroma, seborrheic keratosis, hemangioma, melanoma, Spitz nevi, and clear cell acanthoma),[14,21,22] and in the assessment of borders in some tumoral pathologies (e.g., lentigo maligna, basal cell carcinoma)[23,24]
Allows digital surveillance and monitoring of melanocytic lesions[25,26]
Allows clinician to formulate a more precise differential diagnosis (clinical-dermoscopy concordance)
Enhances confidence in the clinical diagnosis
Improves the diagnostic accuracy, sensitivity, and specificity for the diagnosis of melanoma[6,20]
Isolates suspicious areas within a lesion to help guide step-sectioning, which is performed by the pathologist
Reassures patients and physicians[27]
Reduces the number of unnecessary biopsies[3,27,28]
Limitations
Anchoring bias (relying too heavily on one piece of information) and search satisfaction (basing a diagnosis on incomplete information and ending the search)
Can result in lower diagnostic accuracy if the physician does not recognize or correctly interpret the significance of structures[29]
May not detect early melanomas that have not yet developed any specific dermoscopic criteria[30]
Lower diagnostic accuracy when lesions are diagnosed using dermoscopy alone, without clinical context[31,32]

Information from references 3, 6, 14, and 20 through 32.

Table 4. Dermoscopic Criteria for Melanocytic and Nonmelanocytic Lesions

Level	*Type of lesion*	*Dermoscopic criteria*
1	Melanocytic lesions	Pigment network*
		Negative pigment network
		Aggregated globules
		Streaks (pseudopods and radial streaming)
		Homogeneous blue pigmentation
		Pseudonetwork (facial skin)
		Parallel pigment pattern (acral lesions on palms and soles)
2	Basal cell carcinoma†[35]	Arborizing blood vessels
		Leaf-like structures
		Large blue-gray ovoid nests
		Multiple blue-gray nonaggregated globules
		Spoke wheel–like structures/concentric structures
3	Seborrheic keratosis‡[36,37]	Multiple (thee or more) milia-like cysts
		Comedo-like opening
		Moth-eaten borders
		Gyri (ridges) and sulci (fissures)
		Fingerprint-like structures
4	Hemangioma/ angiokeratoma[36]	Red, maroon, or black lacunae
5	Blood vessels seen in nonmelanocytic tumors[22,36]	Arborizing, glomerular, hairpin, crown, and serpiginous vessels
6	Blood vessels seen in melanocytic tumors[21,36]	Comma-shaped, dotted, serpentine or irregular linear, polymorphous, and corkscrew vessels; milky-red globules/ vascular blush
7	Structureless lesions[36]	No structures or blood vessels noted

**—Although pigment network is a structure seen in melanocytic lesions, it can also be seen in dermatofibroma. Dermatofibromas are characterized by a peripheral delicate pigment network with a central scar-like area. An additional clue to the diagnosis of dermatofibroma can be obtained by palpation, which will reveal a firm lesion that dimples inward when lateral pressure, directed toward the lesion, is applied at the lesion's edge.*

†—Additional features for basal cell carcinoma include white shiny structures (i.e., white shiny areas and white shiny streaks, also known as crystalline structures)[38] and ulceration not associated with a history of trauma (sensitivity of 27%).[35] Overall, the aforementioned model has a sensitivity of 97% for the diagnosis of pigmented basal cell carcinoma.[35,38]

‡—An additional feature of seborrheic keratosis is sharp demarcation.

Information from references 21, 22, and 35 through 39.

carcinomas can reveal vascular structures such as arborizing blood vessels[36,38] *(Table 4[21,22,35-39]; Figure 4)*. In addition, pigmented basal cell carcinoma can demonstrate pigmented structures, including leaf-like structures, spoke wheel–like structures, ovoid nests, and nonaggregated blue-gray globules.

Seborrheic keratosis is one of the most common benign epidermal tumors. Clinically, these lesions are characterized by well-circumscribed plaques or papules with pseudohorn cysts. They range from light brown to dark brown or black. Dermoscopically, seborrheic keratoses display multiple milia-like cysts, comedo-like openings, gyri and sulci, fingerprint-like structures, and moth-eaten borders *(Table 4[21,22,35-39]; Figure 5)*.

Cherry hemangiomas are bright red to violaceous papules that consist of dilated capillaries. Similarly, angiokeratomas are dark violaceous to black papules that are often keratotic or firm on palpation. Dermoscopically, hemangiomas and angiokeratomas are distinguished by the presence of well-demarcated lacunae that can be red, maroon, blue, or black[36] *(Table 4[21,22,35-39]; Figure 6)*.

Some lesions, particularly amelanotic or hypomelanotic tumors, cannot be classified based on the aforementioned features. It is important to search for the presence of blood vessels in these lesions. If present, the blood vessel morphology can assist in making the correct diagnosis. In most amelanotic and hypomelanotic lesions, the only clue to the diagnosis depends on evaluating the blood vessel morphology and distribution, whereas in pigmented lesions (as previously mentioned), the analysis of vascular structures provides secondary clues to the diagnosis.[21,40]

The easiest way to visualize blood vessels is to use a noncontact polarized dermatoscope. If a contact dermatoscope is used, it is beneficial to use ultrasound gel as the liquid interface, because the gel acts as a cushion that minimizes the amount of pressure applied to the skin, which in turn prevents blanching of the vessels.[21] Although it is important to analyze blood vessel morphology, especially in amelanotic lesions, it is beyond the scope of this article to review all the vessel morphologies; readers should refer to the referenced articles for more information.[21,22]

Interpretation of Dermoscopic Structures: The Two-Step Algorithm

The two-step dermoscopy algorithm is the foundation for dermoscopic evaluation of skin lesions, and it guides the observer through the diagnosis and management decision-making process[36] *(Figure 7)*.

FIRST STEP: MELANOCYTIC VS. NONMELANOCYTIC LESIONS

The first step of the algorithm is based on a seven-level criterion ladder, which is intended to help differentiate melanocytic lesions from the following nonmelanocytic

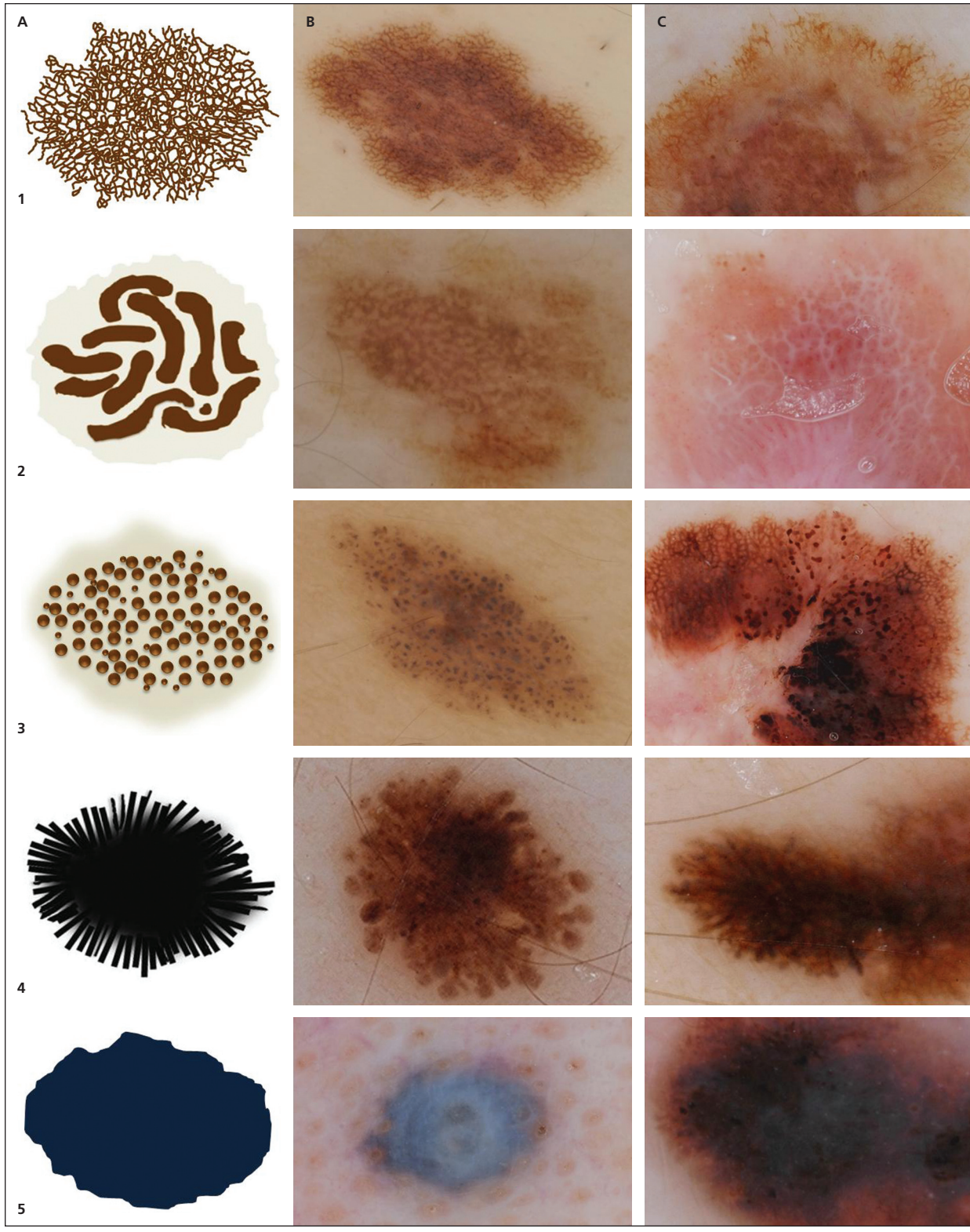


Figure 2. Dermoscopic structures in melanocytic lesions. Column A shows a schematic of the dermoscopic structure, and columns B and C show a benign and malignant example, displaying the specific structure. *(1A)* Pigment network schematic. *(1B)* Regular pigment network in a melanocytic nevus. *(1C)* Atypical pigment network in a melanoma. *(2A)* Negative pigment network schematic. *(2B)* Central and symmetric negative pigment network in a melanocytic nevus (combined Spitz nevi). *(2C)* Negative pigment network in a melanoma. *(3A)* Aggregated globules schematic. *(3B)* Aggregated globules in a melanocytic nevus. *(3C)* Atypical globules and atypical pigment network in a melanoma. *(4A)* Streaks schematic. *(4B)* Streaks (pseudopods) in a Spitz nevus (benign). *(4C)* Atypical streaks in a melanoma. *(5A)* Homogeneous blue pigmentation schematic. *(5B)* Homogeneous blue pigmentation in a blue nevi. *(5C)* Homogeneous blue pigmentation with heterogeneous hues present focally in a melanoma.

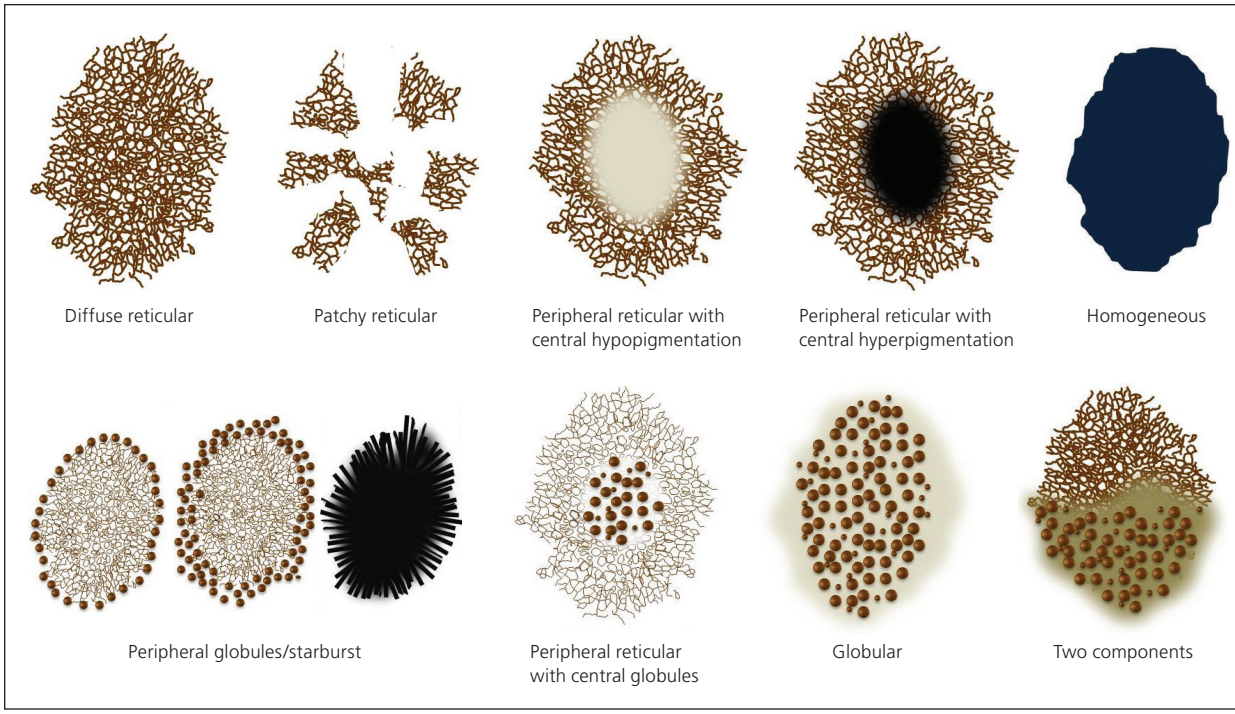


Figure 3. Dermoscopic patterns of melanocytic nevi.

lesions: dermatofibroma, basal cell carcinoma, seborrheic keratosis, and hemangioma[36] *(Table 4[21,22,35-39]; Figure 7)*. Even if the two-step algorithm cannot reliably differentiate between melanocytic and nonmelanocytic lesions, it has been structured to ensure that cutaneous malignancies will not be missed.[36,39] For example, occasionally basal cell carcinoma and melanoma can manifest overlapping features that may lead to the incorrect classification of some basal cell carcinomas as melanocytic (i.e., melanoma) and some melanomas as nonmelanocytic (i.e., basal cell carcinoma). Despite this potential error, the concern for a cutaneous malignancy will remain high, and the management decision to perform a biopsy will not be altered.

SECOND STEP: BENIGN VS. MALIGNANT MELANOCYTIC LESIONS

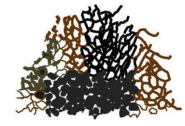
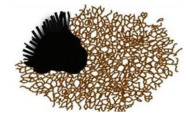
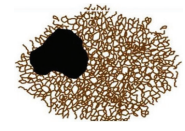
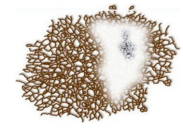
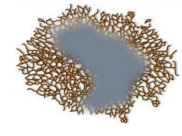
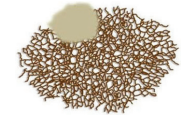
The second step of the algorithm is intended only for the evaluation of melanocytic lesions, including common acquired melanocytic nevi, blue nevi, Spitz nevi, atypical nevi, and melanoma. In essence, the second step is intended to help differentiate nevi from melanoma.[36] To accomplish this, numerous quantitative and qualitative methods have been created.[34,41-45] In particular, scoring systems have proven to be relatively simple, accurate, and reproducible methods for diagnosing melanoma.[6,19,44]

The three-point checklist is considered the simplest method to learn and use, and has the highest sensitivity for identifying melanoma[36] *(Figure 8)*. It is intended as a screening algorithm for detecting skin cancer (melanoma and pigmented basal cell carcinoma) and applies only to pigmented skin lesions. One point is assigned to each of the following criteria present in the lesion[43]:

- Asymmetry in distribution of dermoscopic color and/or structures in one or two perpendicular axes. The contour or silhouette of the lesion does not factor into whether the lesion is symmetric or not.
- Irregular or atypical pigment network consisting of thick lines and irregular holes.
- Blue-white veil and/or white scar-like depigmentation and/or blue pepper-like granules.

A total score of 2 or 3 is considered positive, and the lesion should be biopsied or the patient referred for further evaluation.[43] Given its simplicity and high sensitivity for detecting pigmented skin cancer, the three-point checklist may be ideally suited for clinicians with little experience in dermoscopy and for use as a screening tool in the primary care setting.[19] Atypical pigment network and blue-white structures have previously been defined *(Figure 2; Table 5; Online Appendix)*. Dermoscopic asymmetry requires further clarification, because it differs from the conventional way that clinicians define asymmetry. The conventional view of asymmetry, as in the well-known ABCD mnemonic for melanoma (asymmetry, border irregularities, color variation, diameter [greater than 6 mm]), factors in the contour or shape of the lesion. In contrast, symmetry or asymmetry in dermoscopy does not factor in the contour or shape, but rather the distribution of colors and structures within the lesion *(Figure 8)*. For example, using the

Table 5. Ten Melanoma-Specific Structures*

Melanoma-specific structure	*Definition*	*Schematic illustration*
Irregular or atypical pigment network	Network with increased variability in the thickness and color of the lines of the network, and increased variability in the size and shape of the holes	
Negative pigment network	Serpiginous interconnecting hypopigmented lines that surround irregularly shaped pigmented structures resembling elongated curvilinear globules	
Streaks (pseudopods and radial streaming)	Radial projections at the periphery of the lesion that are focally and asymmetrically distributed	
Off-centered blotch	Asymmetrically or focally located at the periphery of the lesion Irregular blotch will often reveal differing hues	
Atypical dots or globules	Multiple dots or globules of different size, shape, and color Asymmetrically or focally distributed within the lesion	
Regression structures	Include scar-like depigmentation and peppering, which, when combined, give the appearance of a blue-white veil	
Blue-white veil overlying raised areas	Tends to be asymmetrically located or diffuse throughout the lesion with differing hues	
Atypical vascular structures	Dotted vessels over milky-red backgrounds Serpentine (irregular linear) vessels Polymorphous vessels	
Crystalline structures	White shiny streaks or lines organized orthogonally	
Peripheral brown structureless areas	Tan areas located at the periphery of the lesion that encompass greater than 10% of the lesion	

*—Any of the melanoma-specific structures can also be seen in Spitz nevi.

conventional definition of symmetry, a heart-shaped lesion that reveals only globules would be considered asymmetric in one axis; however, under dermoscopy, this lesion would be considered completely symmetric in both axes.

Pattern analysis is a qualitative method that evaluates dermoscopic structures and their distribution. It requires the ability to recognize, and experience in recognizing, benign patterns[46-48] *(Figure 3)*. It also requires the ability to recognize the 10 melanoma-specific structures listed in *Table 5*. Any melanocytic lesion that deviates from one of these benign patterns, while also revealing at least one of the 10 melanoma-specific structures, should be biopsied to rule out melanoma.

Dermoscopy as a Guide for Management

From a management perspective, the two-step algorithm *(Figure 7)* is intended to guide the decision-making process on whether to perform a biopsy, or to refer or reassure the patient.[49]

If the lesion is considered benign, the patient can be reassured, provided education on skin self-examination, and instructed to return if any changes or new lesions develop.[25,50] If the lesion is suspicious for melanoma or basal cell carcinoma, it should be biopsied.[51] If the lesion is considered suspicious (i.e., the clinician is uncertain of the diagnosis), it can be biopsied or the patient can be referred for another opinion.

All of the criteria discussed in this article can be applied during the evaluation of any lesion on any area of the skin. However, there are additional criteria that are specific to mucosal, volar, and facial skin lesions. For discussion of the specific features of lesions on these areas, refer to the *Atlas of Dermoscopy*[52] or other online tutorials on dermoscopy, such as http://www.dermoscopy-ids.org/index.php/education/podcasts and http://www.genomel.org/dermoscopy.

Dermoscopy is a useful, easy-to-use, and non–time-consuming technique that

SORT: KEY RECOMMENDATIONS FOR PRACTICE

Clinical recommendation	*Evidence rating*	*References*
Dermoscopy aids clinical examination in differentiating melanoma and basal cell carcinoma from benign skin lesions.	C	6, 17, 20
The first step in the two-step algorithm for dermoscopy is intended to help differentiate melanocytic lesions from nonmelanocytic lesions; however, its main objective is to prevent clinicians from missing melanomas.	C	36, 39
The second step in the two-step algorithm for dermoscopy is intended to help differentiate nevi from melanoma.	C	36

A = consistent, good-quality patient-oriented evidence; B = inconsistent or limited-quality patient-oriented evidence; C = consensus, disease-oriented evidence, usual practice, expert opinion, or case series. For information about the SORT evidence rating system, go to http://www.aafp.org/afpsort.

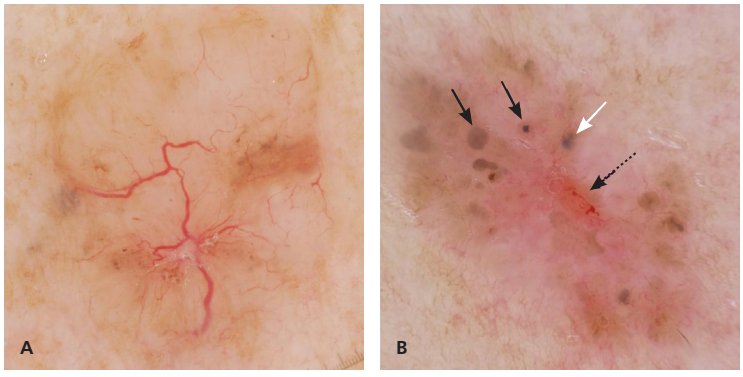


Figure 4. Dermoscopy of basal cell carcinoma. *(A)* Arborizing blood vessels in a nonpigmented basal cell carcinoma. *(B)* Concentric structures (variant of spoke wheel–like structures; *black solid arrows*), blue ovoid nest *(white arrow)*, and ulceration *(dashed arrow)* in a pigmented basal cell carcinoma.

increases diagnostic accuracy for pigmented and nonpigmented skin lesions[53]; in particular, it increases the sensitivity for detecting melanoma and basal cell carcinoma. In addition, dermoscopy has been shown to improve specificity by decreasing the number of biopsies of benign lesions, such as nevi, seborrheic keratosis, and hemangioma, that may clinically mimic malignancy.[28]

Data Sources: A PubMed search was completed in Clinical Queries using the key terms dermoscopy, dermatoscopy, epiluminescence microscopy, skin surface microscopy, and incident light microscopy. The search included meta-analyses, randomized controlled trials, clinical trials, reviews, and case series.

Editor's Note: At the time of initial submission, Dr. Marghoob did not list any disclosures on *AFP*'s Conflict of Interest form, which asks for financial relationships with commercial entities that might have an interest in the topic. During the final stages of production, we discovered that Dr. Marghoob had the following relationships with makers of dermoscopes, which we agreed should be disclosed: (1) receiving dermoscope prototypes for testing from the four major manufacturers, and providing unpaid feedback and advice about these devices; (2) receiving honoraria for speaking on the topic of dermoscopy at meetings funded in part by makers of dermoscopes (however, Dr. Marghoob is not on any speakers' bureaus); and (3) being an investigator in Institutional Review Board–approved research projects funded by the National Institutes of Health and Melanoma Research Alliance, some of which partnered (at least to some extent) with companies that produce dermoscopes (however, Dr. Marghoob does not receive any compensation from this grant funding). Given the stage at which these conflicts came to our attention, we performed an internal review

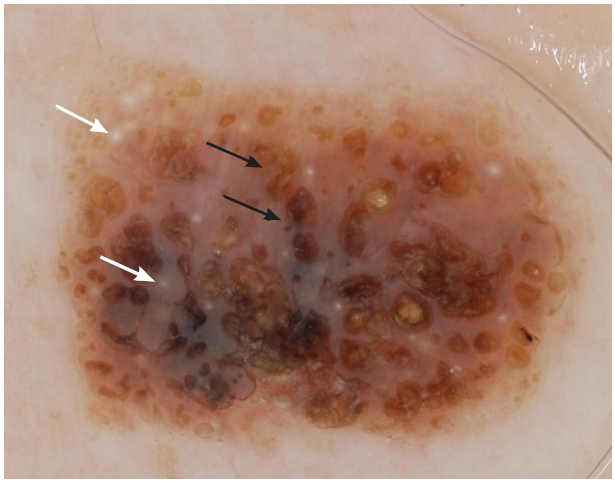


Figure 5. Milia-like cysts *(white arrows)* and comedo-like openings *(black arrows)* in a seborrheic keratosis.

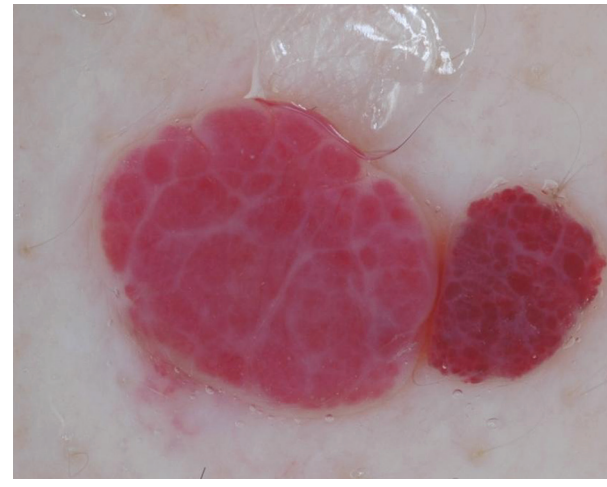


Figure 6. Red lacunae in two cherry angiomas adjacent to each other.

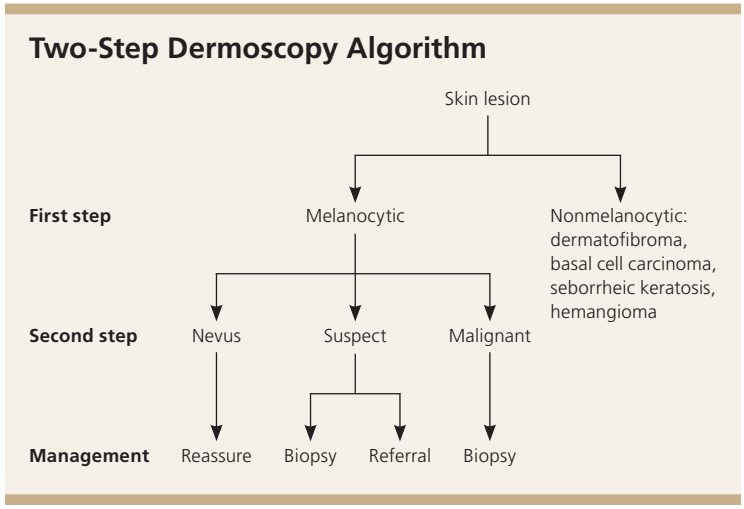


Figure 7. The two-step algorithm for dermoscopy.

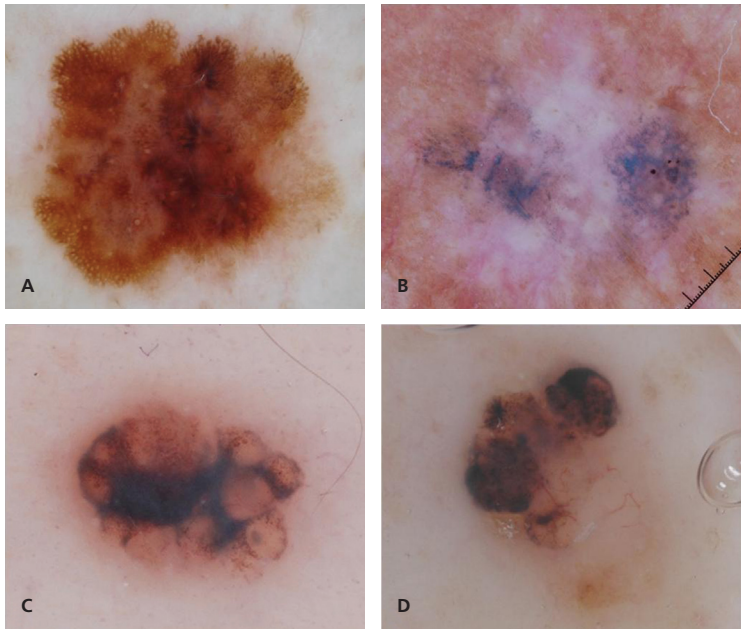


Figure 8. Use of the three-point checklist on four example lesions. One point is assigned to each of the three criterion present in the lesion. A total score of 2 or 3 is considered positive, and the lesion should be biopsied or the patient referred for further evaluation. Lesion A demonstrates asymmetry of dermoscopic pattern and atypical pigment network (total of two points; diagnosis of melanoma 0.3 mm). Lesion B demonstrates asymmetry of dermoscopic pattern and blue-white structures (total of two points; diagnosis of melanoma in situ). Lesions C and D demonstrate asymmetry of dermoscopic pattern and blue-white structures (total of two points; diagnosis of basal cell carcinoma). Note that lesion C has a clinically symmetric oval contour, but it is dermoscopically asymmetric because of the asymmetric distribution of colors and structures within the lesion.

of the manuscript and disclosures, and ultimately decided that the manuscript provided an unbiased and nonpromotional description of this technique. In addition, Dr. Marghoob agreed to not enter into any relationships with a maker of dermoscopes that used his *AFP* article for any presentations on dermoscopy for at least 12 months after the article's publication. For these reasons, we decided to continue with publication. However, to be clear, relationships like these would generally be disqualifying according to our conflict of interest policy (http://www.aafp.org/journals/afp/authors/guide/coi.html).

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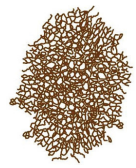
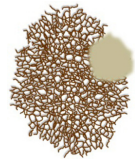
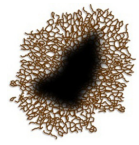
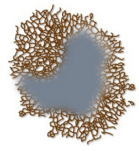
Appendix
Melanocytic Neoplasms: Dermoscopic Structures and Histopathologic Correlation

Dermoscopic structures	*Schematic illustration*	*Definition*	*Histopathologic correlation*
Pigment network		Grid-like network consisting of pigmented lines and hypopigmented holes	Melanin in keratinocytes or melanocytes along the dermoepidermal junction Network lines correspond to the rete ridges Holes correspond to the suprapapillary plate
Pseudonetwork		Diffuse pigmentation interrupted by adnexal opening Usually seen in facial lesions	Pigment in the epidermis or dermis in which the rete ridges are attenuated
Negative pigment network		Serpiginous interconnecting hypopigmented lines that surround irregularly shaped pigmented structures resembling elongated curvilinear globules	Remains unknown Presumed to be related to bridging of rete ridges or large melanocytic nests in the papillary dermis, resulting in compression of adjacent rete ridges; these nests may correspond to globules that are not spherical in shape
Aggregated globules		More than three clustered, well-demarcated, round to oval, symmetric structures, or three or more of these structures aligned at the lesion's perimeter May be brown, black, or blue Diameters are greater than 0.1 mm	Nests of melanocytes at the dermoepidermal junction
Dots		Small, round structures of less than 0.1 mm in diameter May be black, brown, or blue-gray	Aggregates of melanocytes or melanin granules
Streaks (pseudopods and radial streaming)		Streaks are radial projections at the periphery of the lesion, extending from the tumor toward the surrounding normal skin; may be brown or black	Confluent junctional nests of melanocytes
		Pseudopods are streaks with finger-like projections with small knobs at the tips	
		Radial streaming is streaks without knobs at the tips	
Peppering (or granularity)		Tiny, blue-gray granules	Melanin deposited as intracellular (mostly within melanophages) or extracellular particles in the upper dermis
Structureless areas		Devoid of dermoscopic structures within the lesion and without manifesting any regression structures Tend to be tan to light brown, but have lighter pigment compared with the rest of the lesion	Relative decreased concentration of melanin or flattening of rete ridges

Appendix continues

Melanocytic Neoplasms: Dermoscopic Structures and Histopathologic Correlation *(continued)*

Dermoscopic structures	*Schematic illustration*	*Definition*	*Histopathologic correlation*
Peripheral light brown or tan structureless areas		Structureless areas (as above), located at the periphery of the lesion	Partial or complete flattening of the rete ridges Increased number of pigmented atypical melanocytes predominantly at the dermoepidermal junction Diffuse scattering of melanocytes in the spinous layer of the epidermis
Blotches		Dark brown to black homogeneous areas of pigment that obscure visualization of any other structures	Aggregates of melanin in the stratum corneum or throughout all layers of the skin
Regression structures		Include scar-like depigmentation (lighter than the surrounding uninvolved normal skin; appear shiny white under polarized dermoscopy) often combined with peppering; combination of scar-like depigmentation and peppering gives the appearance of a blue-white veil	Scar-like changes/white areas: thickened fibrotic papillary dermis Blue areas: correlate with melanosis type of regression
Blue-white veil		Confluent blue pigmentation with an overlying white ground-glass haze	Aggregation of heavily pigmented melanocytes or melanophages in combination with compact orthokeratosis of the stratum corneum
White shiny structures (more conspicuous with polarized dermoscopy)		Rosettes: appear as four white shiny points creating a pattern reminiscent of a four-leaf clover[A4]	Histopathologic correlation has not been fully explained
		Crystalline structures: short, white, shiny linear streaks that are often parallel or orthogonal to each other[A5,A6]	Altered collagen or fibrosis in the dermis
		White shiny areas: appear as larger structureless areas of shiny white color	Altered stromal matrix
Parallel pigment pattern		On volar skin (i.e., palms and soles) Parallel rows of pigmentation following the furrows (as seen in nevi) or ridges (as seen in melanoma) of the dermatoglyphics	Pigmented melanocytes in the furrows (crista limitants) or ridges (crista intermedia) on skin of palms and soles

Appendix continues

Information from references A1 through A6.

Nonmelanocytic Neoplasms: Dermoscopic Structures and Histopathologic Correlation *(continued)*

Dermoscopic structures	*Schematic illustration*	*Definition*	*Histopathologic correlation*
Milia-like cysts		Round whitish or yellowish structures that shine brightly (like "stars in the sky") under nonpolarized dermoscopy Further subclassified as small and starry, and as large and cloudy[A9]	Intraepidermal keratin-filled cysts
Comedo-like openings		Blackhead-like plugs on the surface of the lesion	Concave invaginations in the surface of the epidermis filled with keratin; some of these invaginations may correspond to follicular openings filled with keratin
Fingerprint-like structures		Delicate, thin, light brown parallel running lines that do not interconnect to form a grid	Epidermal ridges
Gyri and sulci		Gyri (ridges or fat fingers) and sulci (fissures) that create a cerebriform surface These invaginations can be filled with keratin, creating crypts	Epidermal ridges with or without keratin filling the invaginations
Moth-eaten borders		Concave invaginations of the lesion border	—
Pigment network–like structure		Grid-like pattern that can resemble the pigment network seen in a melanocytic neoplasm Correspond to interconnecting epidermal ridges on the skin; the holes correspond to comedones or crypts Lines tend to appear broader compared with the pigment network seen in nevi	Ridges, crypts, and comedo-like openings distributed in a manner that gives the appearance of a grid
Leaf-like structures		Brown to gray-blue discrete bulbous structures that may coalesce to create a shape that resembles a leaf	Large pigmented basal cell carcinoma tumor nests in the upper dermis
Spoke wheel–like/ concentric structures		Well-circumscribed brown to gray-blue-brown radial projections meeting at a darker brown central hub	Basal cell carcinoma tumor nests radiating from the dermoepidermal junction
Large blue-gray ovoid nests		Large, well-circumscribed ovoid areas; larger than globules	Large basal cell carcinoma tumor nests in the dermis

Appendix continues

Nonmelanocytic Neoplasms: Dermoscopic Structures and Histopathologic Correlation *(continued)*

Dermoscopic structures	*Schematic illustration*	*Definition*	*Histopathologic correlation*
Blue-gray globules or dots		Multiple, nonaggregated, round, well-circumscribed structures	Small basal cell carcinoma tumor nests in the dermis
Lacunae		Red (hemangioma), maroon (hemangioma and angiokeratoma), or black (angiokeratoma) lagoons often separated by septae	Dilated vascular spaces

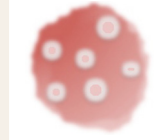
Information from references A1, A2, and A7 through A9.

Vascular Structures Most Commonly Seen in and Associated with Nonmelanocytic Tumors

Dermoscopic structures	*Schematic illustration*	*Definition (morphology)*	*Diagnostic associations*
Glomerular vessels		Coiled vessels mimicking the glomerular apparatus of the kidney	Bowenoid actinic keratosis, Bowen disease/squamous cell carcinoma[A11,A13] Clear cell acanthoma
Hairpin vessels		U-shaped vessels Not infrequently, may be twisted on its axis Background: white halo common in keratinocytic tumors	Keratinizing tumors such as keratoacanthoma and seborrheic keratosis[A7,A11,A14]
		U-shaped vessels Not infrequently, may be twisted on its axis Background: pink halo or pink background common in irritated seborrheic keratosis, but can also be seen in cutaneous malignancies	Irritated seborrheic keratosis, melanoma, basal cell carcinoma[A15]
Arborizing vessels		Vessels with large diameter, branching irregularly into fine capillaries	Basal cell carcinoma[A11,A13] Can also be seen in cysts, furuncles, and other adnexal tumors
Crown vessels		Branching or nonbranching vessels radiating toward the center of the lesion but without crossing its center Often associated with white/yellowish popcorn-like globular structures	Sebaceous hyperplasia[A11] Molluscum contagiosum

Appendix continues

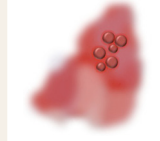
Vascular Structures Most Commonly Seen in and Associated with Nonmelanocytic Tumors *(continued)*

Dermoscopic structures	*Schematic illustration*	*Definition (morphology)*	*Diagnostic associations*
Dotted or glomerular vessels in "string of pearls" or serpiginous distribution		Vessels distributed in a serpiginous pattern	Clear cell acanthoma
Strawberry pattern		White-yellow follicular openings surrounded by a white halo, over a red background	Actinic keratosis[A16]

NOTE: *The presence of a given vessel morphology is not exclusive to a particular diagnosis. For example, arborizing vessels are commonly seen in basal cell carcinoma, but they can also, on rare occasions, be seen in melanoma and intradermal nevi. Another example, hairpin vessels, are commonly associated with seborrheic keratoses, but they can also be seen in melanoma. With that said, this appendix highlights vessels that are most commonly associated with nonmelanocytic tumors.*

Information from references A7, and A10 through A16.

Vascular Structures Most Commonly Seen in and Associated with Melanocytic Tumors

Dermoscopic structures	*Schematic illustration*	*Definition (morphology)*	*Diagnostic associations*
Comma-shaped vessels		Slightly curved vessels	Dermal nevi, congenital melanocytic nevi[A11]
Dotted vessels		Red dots (0.01 to 0.02 mm)	Spitz nevi, early melanoma (dotted over milky-red background)[A11] Clark nevi (dotted over tan background)
Serpentine vessels		Irregular linear/undulating short vessels	Melanoma, congenital nevi[A11]
Milky-red globules/ vascular blush		Ill-defined globules of milky-red color and ill-defined areas of milky-red color	Amelanotic melanoma[A11]
Polymorphous vessels		Combination of two or more vessel morphologies Most common combination is dotted and serpentine vessels	Melanoma[A14]

Appendix continues

Vascular Structures Most Commonly Seen in and Associated with Melanocytic Tumors *(continued)*

Dermoscopic structures	*Schematic illustration*	*Definition (morphology)*	*Diagnostic associations*
Corkscrew vessels		Coiled and tortuous vessels	Cutaneous melanoma metastases, nodular melanoma, desmoplastic melanoma

NOTE: *The presence of a given vessel morphology is not exclusive to a particular diagnosis. For example, dotted vessels can be seen in melanocytic tumors, but they can also be seen in squamous cell carcinoma,[A12] basal cell carcinoma,[A15] porokeratosis,[A17] and clear cell acanthoma.[A12] Another example, polymorphous vessels, are commonly associated with melanoma, but they can also be seen in basal cell carcinoma,[A15] and stasis dermatitis. With that said, this appendix highlights vessels that are most commonly associated with melanocytic tumors.*

Information from references A10 through A12, and A14, A15, and A17.

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