



An Algorithmic Dermatoscopic Approach to Nonpigmented Skin Tumors

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Key words: Skin neoplasms, Dermatoscopy, Dermoscopy, Melanoma, Basal cell carcinoma, Algorithms

Citation: Lallas A, Argenziano G. An Algorithmic Dermatoscopic Approach to Nonpigmented Skin Tumors. *Dermatol Pract Concept*. 2026;16(2):7541. DOI: <https://doi.org/10.5826/dpc.1602a7541>

Accepted: March 27, 2026; **Published:** April 2026

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Funding: None.

Competing Interests: None.

Authorship: All authors have contributed significantly to this publication.

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ABSTRACT **Introduction:** Nonpigmented skin tumors represent a major diagnostic challenge in dermatoscopy. In the absence of pigment, traditional pattern recognition is often unreliable, increasing the risk of misdiagnosis, particularly for melanoma and other aggressive malignancies. **Objectives:** To summarize key dermatoscopic features of nonpigmented skin tumors and to propose structured algorithms for the management of nonpigmented nodular and flat lesions. **Methods:** A narrative review of the literature was conducted focusing on dermatoscopic criteria relevant to nonpigmented lesions, including vascular morphology, white-colored structures, and ulceration. Based on these features, pragmatic algorithms were developed to guide clinical decision-making. **Results:** While vascular structures represent the most informative dermatoscopic features in nonpigmented tumors, their specificity is limited. White-colored structures and ulceration provide additional, nonspecific clues. For nodular lesions, an exclusion-based algorithm centered on common benign entities supports conservative management only when diagnostic confidence is high; otherwise, excision is recommended. For flat lesions, a stepwise assessment of ulceration, vascular morphology, and surface keratin allows differentiation between superficial basal cell carcinoma, Bowen's disease, and lesions requiring biopsy. **Conclusions:** Simple, conservative dermatoscopic algorithms may improve the safety and consistency of clinical decision-making in nonpigmented skin tumors, supporting early detection of malignancies while accepting a degree of benign excisions.

Introduction

Dermatoscopy has substantially improved the diagnosis of pigmented skin tumors. For most melanocytic and non-melanocytic pigmented lesions, established criteria and pattern recognition enable rapid and reliable diagnostic decisions in routine practice [1,2]. By contrast, nonpigmented tumors remain a major diagnostic problem: in the absence of pigment, morphology is frequently insufficient, pattern recognition often fails, and the risk of missing melanoma and other malignancies increases [3–5].

A reader study on nonpigmented lesions involving clinicians with variable experience showed that dermatoscopy improves the clinical diagnosis, but that accuracy remains low, with less than half of the evaluated tumors being correctly classified [3]. Nonpigmented lesions are also challenging for artificial intelligence (AI)-based image analysis, highlighting the inherent limitations of dermatoscopic morphology in this category of tumors [6].

In this context, simple dermatoscopic algorithms for nonpigmented nodules and flat lesions can serve as pragmatic tools to support safe clinical decision-making. Their primary aim is not fine-grained classification but a reduction in false-negative diagnoses, especially of melanoma and other aggressive tumors. These algorithms privilege clear management thresholds over reliance on isolated dermatoscopic “clues” [5,7].

Vascular Morphology in Nonpigmented Lesions

When pigment is absent, vascular structures become key dermatoscopic features [4,8]. Six main vessel morphologies are commonly recognized in skin tumors: dotted, coiled, comma, hairpin, linear ramified, and linear-irregular vessels [4

(Figure 1). These may be arranged in several patterns, such as regular, reticular, clustered, radial, branching, or chaotic/asymmetric.

Certain vessel types preferentially occur in specific tumor categories. In melanocytic lesions, comma vessels are frequent in dermal nevi, dotted vessels in Spitz nevi and spitzoid melanomas, and linear-irregular vessels in superficial spreading melanomas (Figure 2) [4,8]. In non-melanocytic tumors, coiled or glomerular vessels are typical of Bowen’s disease, hairpin or glomerular vessels of keratinizing tumors such as squamous cell carcinoma and seborrheic keratosis, and linear ramified (“arborizing”) vessels of basal cell carcinoma (BCC) and various adnexal neoplasms (Figure 3) [4,8].

While these associations are useful, in nonpigmented lesions they are rarely sufficient to justify conservative management without a structured framework. Algorithms help translate vascular and surface features into reproducible management decisions [5,7].

White-Colored Structures in Nonpigmented Lesions

White-colored structures are often seen in nonpigmented tumors, but they are rarely specific enough to support a definite diagnosis [8,9]. White-colored structures may be classified as shown in Figure 4.

White structureless areas histopathologically correspond to either fibrosis, particularly when observed in clinically flat lesions, or epidermal hyperplasia, when seen in elevated/nodular tumors [9,10]. Fibrosis occurs in various tumors (dermatofibroma, morpheaform BCC, melanoma, sclerosing nevi, traumatized tumors) as well as in inflammatory dermatoses. Similarly, epidermal hyperplasia is

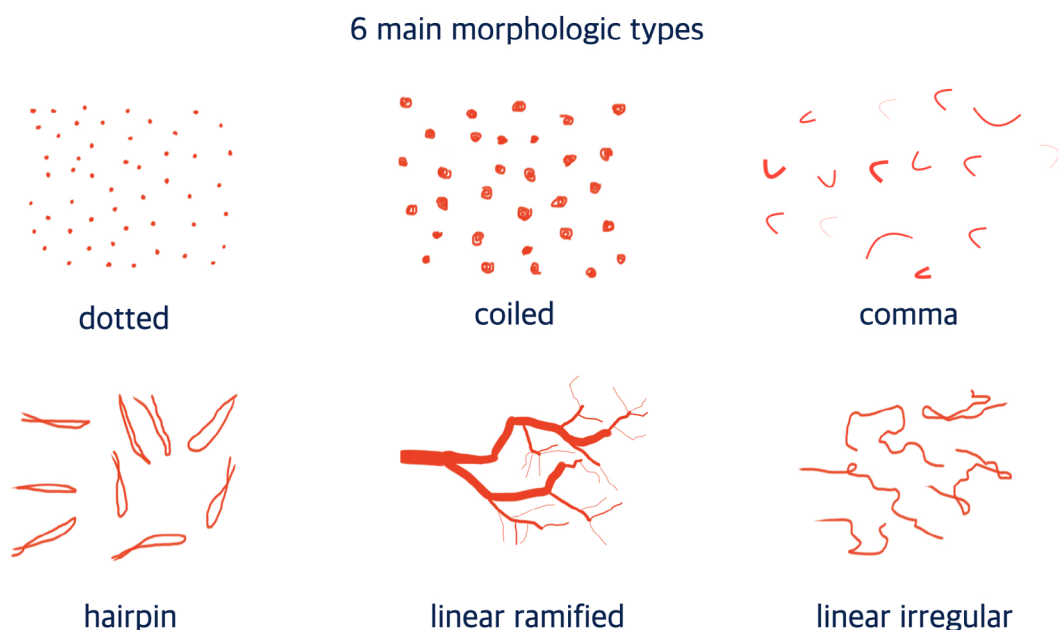


Figure 1. Six main morphological types of vessels commonly recognized in skin tumors.

3 main vessel types in melanocytic tumors



Figure 2. Three main vessel types in melanocytic lesions.

3 main vessel types in non-melanocytic tumors

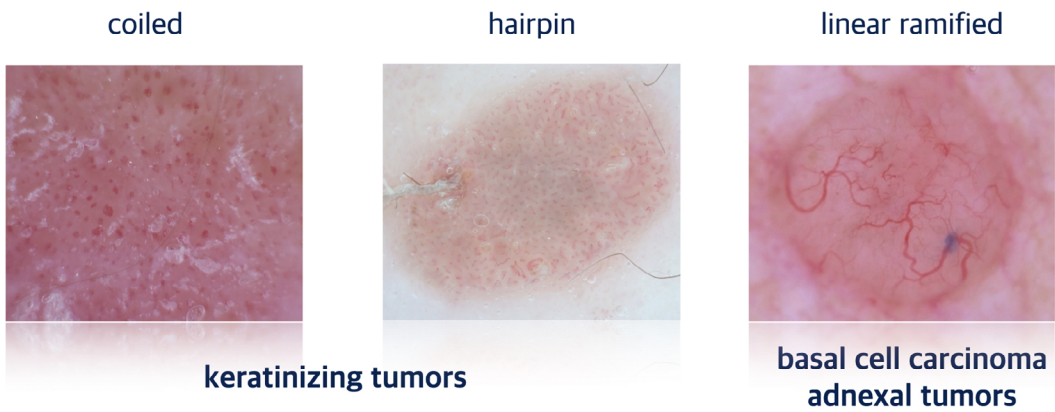


Figure 3. Three main vessel types in non-melanocytic lesions.

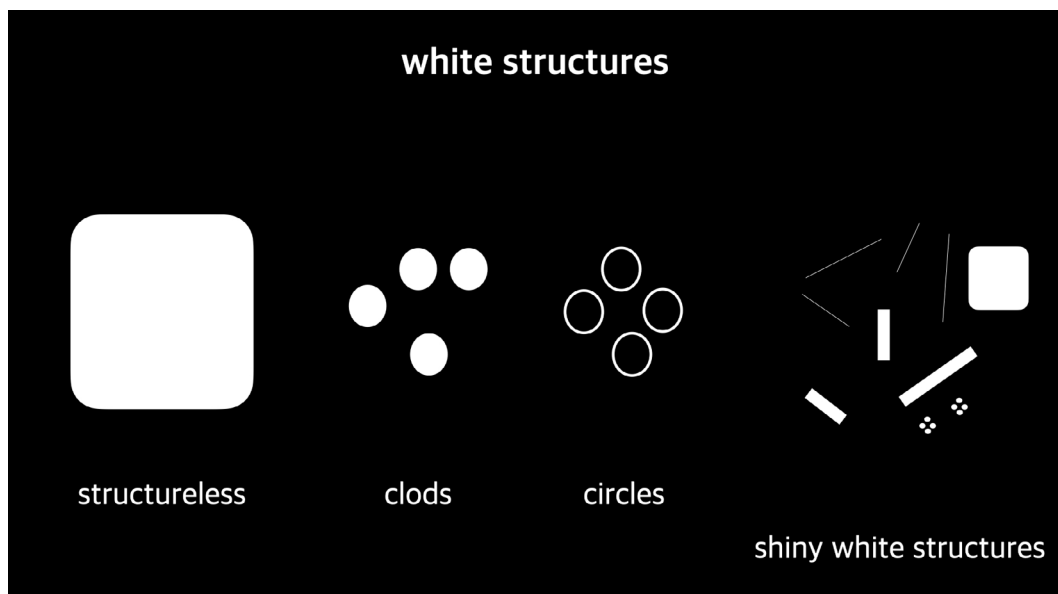


Figure 4. White-colored structures often seen in nonpigmented tumors.

typical of squamous cell carcinoma (SCC), but it can also occur in other benign and malignant tumors. Therefore, white structureless color cannot be considered a specific diagnostic clue.

White globules or clods usually correspond to keratin masses and typify keratinizing tumors such as SCC and seborrheic keratosis [11-13]; however, BCC and other tumors may also exhibit signs of keratinization. Less frequently, white globules may result from calcifications, as described primarily, though not exclusively, in BCC [14].

White circles represent one of the relatively more specific dermatoscopic features in nonpigmented tumors. Perifollicular white circles were shown to correspond to hyperplasia of the follicular epithelium, a characteristic feature of SCC [11,15]. Although they may be insufficient to discriminate SCC from actinic keratosis, they effectively differentiate it from other tumors. Notably, perivascular white halos are not SCC-specific since they can be found in various tumors with keratinization [12].

White shiny structures constitute a heterogeneous group of variably shaped features (lines, strands, blotches, follicular dots) that were historically associated with malignant tumors, as they were first described in melanoma and then in BCC [16]. However, recent evidence indicates that they may also be seen in several benign tumors such as dermatofibroma, angioma, and pyogenic granuloma [17].

Ulceration in Nonpigmented Lesions

Dermatoscopic ulceration appears to be more frequently seen in nonpigmented tumors compared to pigmented ones [9]. Among common skin tumors, BCC exhibits ulceration more frequently and often earlier in its course. However, ulceration is not specific to BCC as virtually any tumor may ulcerate [9]. Extensive ulceration may hinder or even preclude accurate dermatoscopic diagnosis (Figure 5).

From Dermatoscopic “Clues” to Structured Decisions

Numerous dermatoscopic features have been proposed as “clues” to amelanotic melanoma, such as polymorphous vessels, linear-irregular vessels, pink coloration, and white shiny streaks [4,8,9]. Although these findings can be helpful, they are insufficiently sensitive or specific to reliably guide management when used in isolation.

The nodular and flat algorithms described here place such clues into a more systematic framework. The intent is to standardize critical decision points, particularly the thresholds for excision and biopsy, and to reduce variability in the management of diagnostically challenging, nonpigmented lesions.

A 4-Step Exclusion-Based Algorithm for Nonpigmented Nodules

For nonpigmented nodules, we propose herein an exclusion-based algorithm for nonpigmented nodules, focusing on a small group of common benign entities (Figure 6). The algorithm tests whether the nodule can be confidently diagnosed as one of the following:

1. Angioma (including angiokeratoma)
 - Dermatology: multiple red lacunae, usually without superimposed true vessels (Figure 7).
 - The presence of distinct lacunae with absence of vascular structures supports the diagnosis.
 - If vessels (dotted, coiled, linear) are seen instead of, or in addition to, lacunae, a benign angioma cannot be reliably assumed.
2. Dermal nevus
 - Dermatology: fat, short, curved (comma-like) vessels, usually on a soft, dome-shaped or papillomatous papule or nodule (Figure 7).

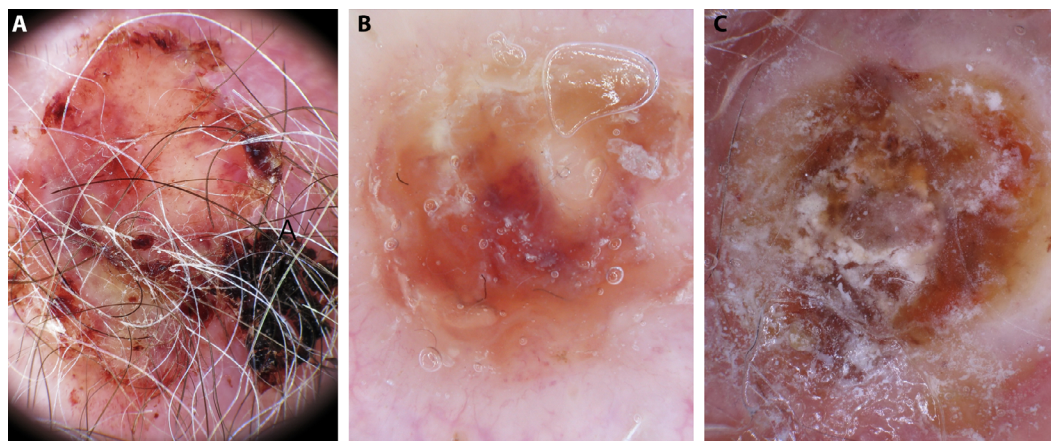


Figure 5. Extensive ulceration may hinder or preclude an accurate dermatoscopic diagnosis (A) Merkel cell carcinoma; (B) Basal cell carcinoma; (C) Squamous cell carcinoma.

Algorithm for non-pigmented nodules

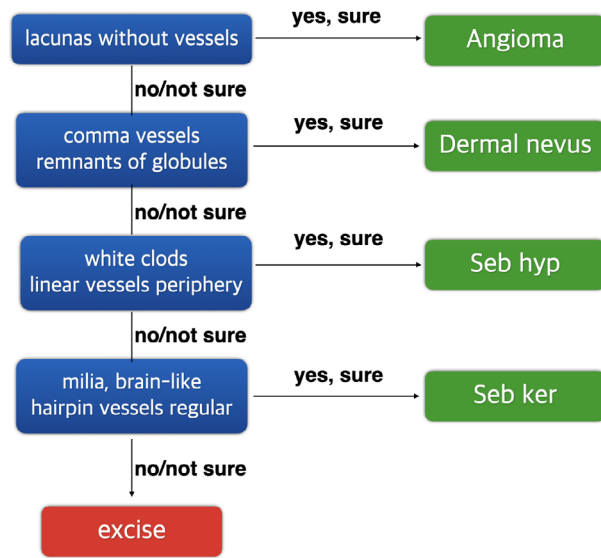


Figure 6. Exclusion-based algorithm for non-pigmented nodules.

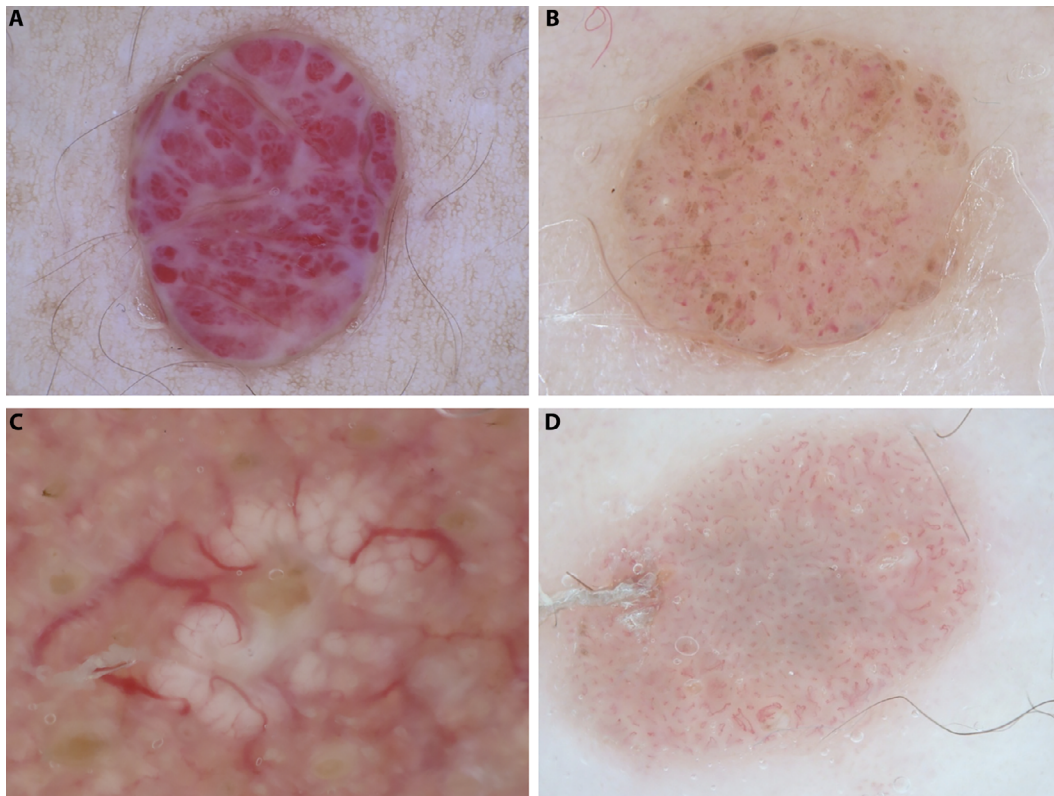


Figure 7. Representative dermatoscopic features of common nonpigmented nodules: (A) angioma with red lacunae; (B) dermal nevus with comma-like vessels; (C) sebaceous hyperplasia with white central clods and crown vessels; (D) nonpigmented seborrheic keratosis with numerous hairpin/glomerular vessels.

- The combination of typical surface morphology and comma vessels often allows a confident benign diagnosis.
3. Sebaceous hyperplasia
 - Dermatoscopy: central white-yellow lobules with peripheral linear vessels that do not cross the lesion center (“crown” vessels) (Figure 7).
 - Vessels traversing the center are atypical and should prompt reconsideration of this diagnosis.
 4. Nonpigmented or irritated seborrheic keratosis
 - Dermatoscopy: numerous hairpin or glomerular vessels with a regular and relatively homogeneous distribution over the lesion (Figure 7).
 - Regularity of vascular distribution is a key criterion; marked irregularity reduces diagnostic confidence.
 A fifth entity, clear cell acanthoma, typically displays a reticular or “string of pearls” arrangement of dotted vessels

and can also be recognized dermatoscopically, though it is less common and not central to the basic algorithm [18].

In practice, the rule is:

- If a nonpigmented nodule can be diagnosed with high confidence as one of these benign tumors, conservative management is acceptable.
- If none of these benign diagnoses can be assigned with sufficient confidence, the lesion should be excised, irrespective of any suspected alternative diagnosis.

With this approach, a wide spectrum of malignant tumors, including nodular amelanotic melanoma, BCC, poorly differentiated SCC, adnexal carcinoma, and atypical fibroxanthoma, will not fit any of the benign categories and will therefore be excised (Figure 8). Inevitably, some benign lesions will also be removed. This is an expected and acceptable consequence of a deliberately conservative algorithm intended to minimize false-negative outcomes.

Algorithm for Flat Nonpigmented Lesions

Flat nonpigmented lesions present a different diagnostic spectrum and therefore require a distinct algorithm. In addition to tumors, various inflammatory skin diseases are included in the differential diagnosis of erythematous macules.

Their clinical diagnosis is based on clinical manifestations, including the type and distribution of the eruption as well as history and symptoms, and can be further supported by dermatoscopy (Figure 9).

After excluding inflammatory dermatoses, three dermatoscopic components are particularly relevant: ulceration /erosions, vascular morphology, and scales or keratin (Figure 10).

A stepwise approach can be summarized as follows:

1. Presence of erosions or ulcerations
 - First, determine whether erosions or ulcerations are present.
 - If so, evaluate vessel morphology:
 - Predominantly short, fine linear vessels in the context of erosions strongly suggest superficial BCC, a frequent flat nonpigmented tumor (Figure 11) [4,9].
2. Absence of erosions/ulcerations
 - When erosions are absent, assess the vessels:
 - If dotted and coiled/glomerular vessels predominate, the next step is to evaluate surface scales and keratin.
 - The presence of white scales and/or yellowish keratin, together with glomerular or coiled vessels, is characteristic of Bowen's disease (Figure 11) [4,9].

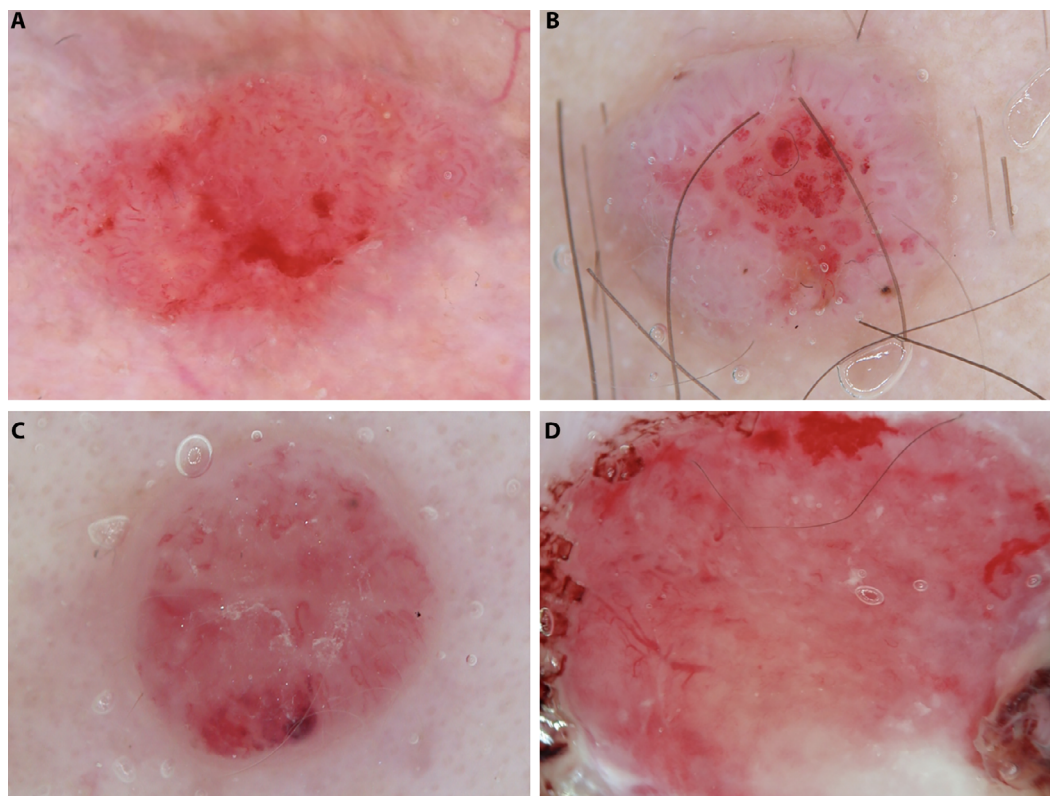


Figure 8. Dermatoscopy of malignant nonpigmented nodules lacking benign-specific patterns: (A–D) examples of tumors not fitting benign criteria and therefore requiring excision (A) poorly differentiated squamous cell carcinoma; (B) adnexal carcinoma; (C) amelanotic melanoma (D) pleomorphic dermal sarcoma.

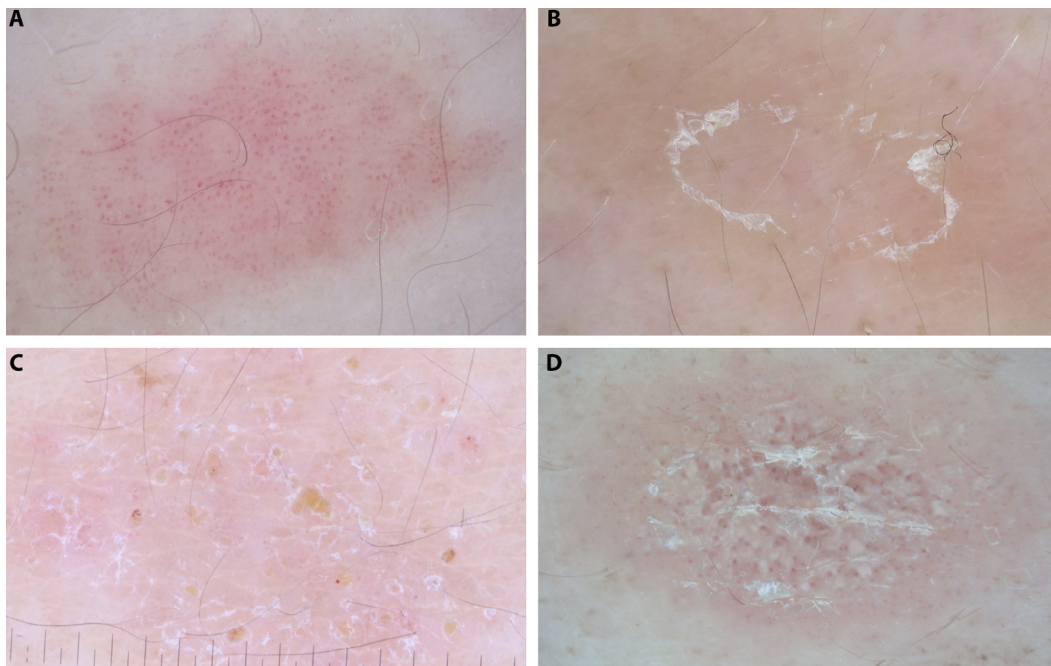


Figure 9. Dermoscopy of flat nonpigmented lesions: representative features of inflammatory erythematous macules: (A) psoriasis with regularly distributed dotted vessels; (B) pityriasis rosea with peripheral white scales; (C) Dermatitis with yellow scales/crusts; (D) lichen planus with white crossing lines (Wickham's striae).

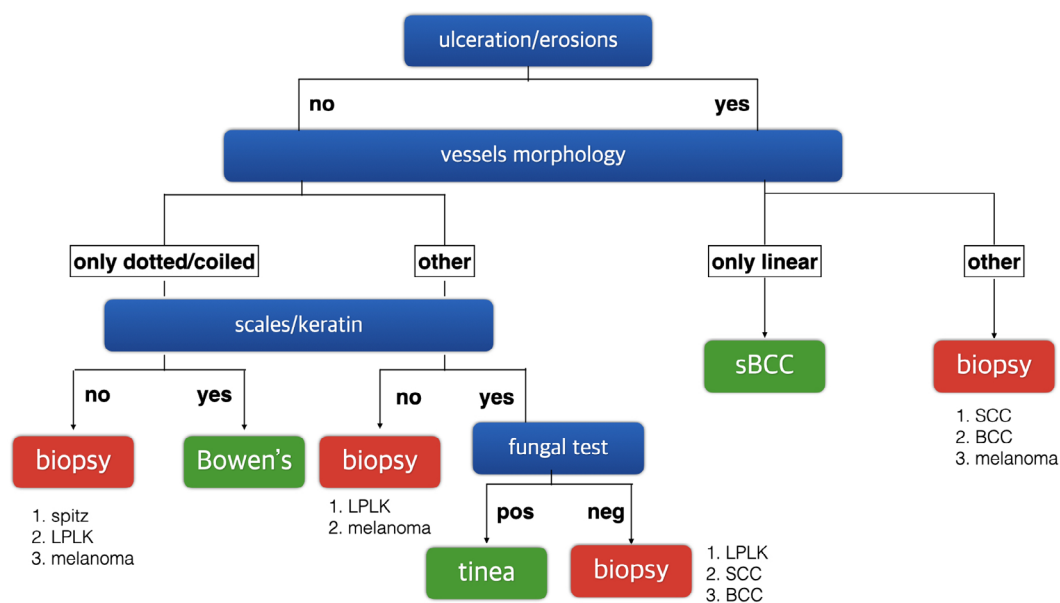


Figure 10. The three relevant components: ulceration/erosions, vascular morphology, and scales or keratin.

3. No erosions and no obvious scales/keratin

- Lesions without erosions and without significant scales or keratin but showing a mixture of dotted and short linear vessels occupy a diagnostically “dangerous” zone.
- The main differential diagnosis in this setting includes lichen planus-like (lichenoid) keratosis and flat amelanotic melanoma, which can be dermatoscopically very similar (Figure 11) [4,6,14].
- White shiny streaks under polarized light, when present, may support melanoma but are not consistently observed [14].

- In this scenario, the algorithm recommends biopsy rather than destructive treatment. Ablative modalities should be avoided as they may eradicate a flat amelanotic melanoma without prior histological confirmation.

Clinical Implications

Routine use of these algorithms has several implications:

- Lower threshold for excision in nonpigmented nodules
Nonpigmented nodules that cannot be confidently categorized into a small set of typical benign diagnoses are

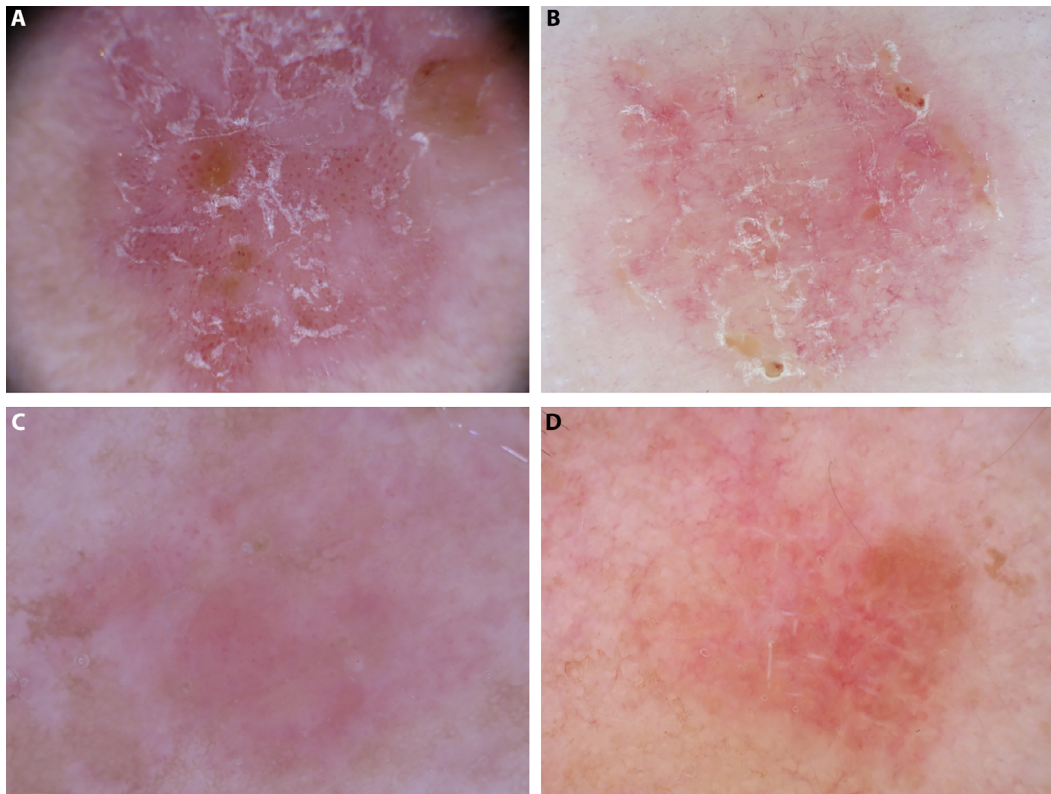


Figure 11. Stepwise dermatoscopic approach for flat nonpigmented lesions: (A) Bowen's disease typified by scales and dotted/coiled vessels; (B) multiple erosions suggesting superficial basal cell carcinoma; (C-D) lesions with dotted and linear vessels without scales or erosions, falling in the 'dangerous' zone. C is lichen planus keratosis and D is an amelanotic melanoma.

excised, reducing the likelihood of missing nodular amelanotic melanoma, aggressive squamous cell carcinoma, adnexal carcinoma, and other malignant neoplasms.

- Structured evaluation of flat lesions

Systematic assessment of erosions, vascular morphology, and scales or keratin improves differentiation between superficial BCC, Bowen's disease, benign inflammatory or lichenoid lesions, and flat amelanotic melanoma.

- Acceptance of some benign excisions

A degree of overtreatment is inherent in any conservative strategy aimed at maximizing sensitivity to malignancy in a difficult diagnostic field. Recognizing this explicitly helps align expectations and supports consistent application of the algorithms.

Conclusion

Nonpigmented skin tumors represent a particularly challenging area in dermatoscopy. In the absence of pigment, reliance on morphology and pattern recognition alone is often inadequate. Simple, conservative dermatoscopic algorithms for nonpigmented nodules and flat lesions, centered on vascular morphology and key surface features, can support safer and more standardized clinical decisions.

For nodules, an exclusion-based approach focusing on a limited set of common benign diagnoses prompts excision when confidence is lacking. For flat lesions, a structured evaluation of ulceration, vascular pattern, and scales or keratin guides the clinician toward superficial BCC, Bowen's disease, or biopsy in cases where melanoma cannot be excluded. Integrating these algorithms into daily practice may reduce missed malignancies and promote more consistent management of nonpigmented tumors in dermatology.

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