

Dermoscopy of Pigmented Skin Lesions*

(Part II)

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Dermoscopy is a non-invasive technique combining digital photography and light microscopy for in vivo observation and diagnosis of pigmented skin lesions. For dermoscopic analysis, pigmented skin lesions are covered with liquid (mineral oil, alcohol, or water) and examined under magnification ranging from 6x to 100x, in some cases using a dermatoscope connected to a digital imaging system. The improved visualization of surface and subsurface structures obtained with this technique allows the recognition of morphologic structures within the lesions that would not be detected otherwise. These morphological structures can be classified on the basis of both global features, allowing a quick, albeit only preliminary categorization of a given pigmented skin lesion, and local features, representing the letters of the dermoscopic alphabet. Classification of melanoma-specific dermoscopic criteria --- namely, atypical pigment network, irregular dots/globules, irregular streak, blue-whitish veil and regression structures, to name the most important ones --- forms the basis of diagnostic algorithms designed to aid the clinician in assessing whether or not a melanocytic lesion is melanoma. A certain number of lesions defy both clinical and dermoscopic diagnosis, and in those cases the ultimate standard for diagnosis is histopathology, especially when performed by well-trained and competent dermatopathologists.

In the first part of this series, we discussed the technical aspects of dermoscopy, describing the various types of instruments used for dermoscopic examination and photographic equipment currently in use. Global features permit a broad classification of pigmented skin lesions, while a description of the local features provides more detailed information about a given lesion. Eight global features of melanocytic lesions were defined: reticular pattern, globular pattern, cobblestone pattern, homogeneous pattern, starburst pattern, parallel pattern, multicomponent pattern, and unspecific pattern. In Part I we also defined 14 local dermoscopic features, such as pigment network, dots and globules, streaks and blue-whitish veil, along with the corresponding histopathological features.

In Part II of this series, we describe in detail the clinical and dermoscopic features of the most important diagnostic categories in dermoscopy, including melanoma and all relevant types of

nevi as well as the non-melanocytic skin tumors that may mimic melanoma. We describe the widely used method of pattern analysis, the classic approach for dermoscopic diagnosis set forth by Pehamberger and colleagues in 1987 (1) that is based on a critical, simultaneous assessment combining global and local dermoscopic features. In an attempt to simplify the dermoscopic approach for diagnosing pigmented skin lesions, alternative diagnostic algorithms have since been proposed, and we summarize three of these: the ABCD rule of dermatoscopy (2), the 7-point checklist (3) and the Menzies' method (4).

I. PIGMENTED SKIN LESIONS

1. Melanoma

Melanoma is a malignant proliferation of melanocytes that has the potential to metastasize. Although the word malignant is commonly used together with melanoma, we prefer to use just the term melanoma throughout this text, because no benign melanoma exists, and the name malignant melanoma is redundant. Melanoma in situ refers to the stage at which the neoplasm is situated within the epidermis and/or epithelium of hair follicles or sweat ducts. Thus, since the melanocytes of a melanoma in situ are not present in the dermis and there is no continuity at all with the vascular plexus, a melanoma in situ should, at least theoretically, have no potential to metastasize.

The incidence of melanoma has increased significantly over the last decades, but fortunately the prognosis has continued to improve because patients are presenting at an earlier stage with smaller and thinner, potentially curable lesions. Still today, despite progress in the treatment of melanoma, the ultimate goal for physicians is to diagnose melanoma in its early evolutionary phases.

Clinical features

The clinical features of melanomas are protean, reflecting the relatively low sensitivity values in the clinical diagnosis of melanoma that range from 67% to 91% (5). Melanoma in situ and early invasive melanoma are usually small, more or less irregularly shaped and outlined macules or

slightly elevated plaques with pigmentation that varies from pink to dark brown. Obviously, the clinical differentiation from Clark nevi is often difficult even for well-trained dermatologists.

Invasive melanomas are, as a rule, papular or nodular, often ulcerated and characteristically exhibit shades of brown and black, but also foci of red, white, or blue coloration. Sometimes they are skin-colored without any brownish-black pigmentation; these are called amelanotic melanoma. Based on a retrospective study of 44258 histopathologically examined skin neoplasms including 529 melanomas, Wolf et al. (5) recently demonstrated that interestingly sensitivity is reduced with thick melanomas, with 64.8% for melanomas with Breslow index $>4\text{mm}$ compared to 72.8% sensitivity for melanoma in situ. Additionally, paramount for the diagnosis are the patient's description of changes in size, color and shape of the lesion and the patient's report of whether any sign of ulceration or spontaneous bleeding was observed. The history provided by the patient must be taken seriously and represents a useful extension of the clinical judgement (6).

Dermoscopic features

Dermoscopic criteria for the diagnosis of melanoma, also called melanoma-specific criteria, have been first elaborated and then tested for their diagnostic validity by several authors during the last few years (7-12).

In order to better systematize these criteria, in Table 1 we have listed the melanoma-specific criteria for the three main anatomic sites, namely, trunk/extremities, face, and palms/soles. In Table 2 the dermoscopic criteria for intermediate and thick melanomas (Breslow index $>0.75\text{mm}$) are summarized. Because the preformed anatomic structures responsible for the site-specific dermoscopic appearance are destroyed by thick melanomas, the dermoscopic features in these melanomas are basically independent of the various sites (13).

2. Clark Nevus

Clark nevi are the most common nevi in man and, moreover, are regarded by many authors as the most relevant precursor lesions of melanoma. Clinical, dermoscopic, and histopathologic

variants of Clark nevi are protean, and the differentiation of Clark nevi from melanoma in situ and early invasive melanomas is the major challenge in the realm of pigmented skin lesions.

Clark nevi were named after Wallace H. Clark, Jr., who, in 1978, first drew attention to this particular type of nevus by studying numerous melanocytic nevi in patients with concomitant melanomas (14).

Clinical features

Clark nevi are flat to elevated or even slightly papillated pigmented lesions characterized by various shades of brown coloration, and situated on the trunk and extremities. They are usually called just common junctional nevi or common compound nevi. Although Clark nevi are found mostly in skin that has been exposed to sunlight, they may be seen also on the buttocks, the volar surfaces and other covered parts such as genitalia and soles. It is fair to say, however, that Clark and coworkers originally meant that this particular type of nevus, called by them dysplastic nevus, actually represents a distinctive precursor lesion of melanoma with special implications on management and treatment of patients bearing these nevi.

Ackerman challenged this concept in a series of articles concluding that there is no unanimity among pathologists, dermatologists, surgeons and other physicians about what this term means and about the reproducibility of the correlation between clinical and histopathologic features (15). Indeed, in the scientific community there is no agreement on the nature of Clark nevi, on what criteria are necessary for diagnosis, both clinically and histopathologically, and on the number of lesions that are needed to have a markedly increased risk to develop melanoma.

We basically agree with Ackerman that Clark nevi are nothing but common 'flat' acquired melanocytic nevi, so frequently found on the trunk and extremities of fair-skinned Caucasians. In our estimation, the real challenge is to recognize within the many variations of Clark nevi those that are actually melanoma in situ or early invasive melanoma. To this end, dermoscopy is essential, and we will describe those variants of Clark nevi that need to be excised or, at least, followed-up closely by using digital equipment. This goal is hampered by the fact that a 'gray zone' between Clark nevi

and melanomas exists and that in a certain number of cases this distinction cannot be made even when using all available technologies.

Dermoscopic features

Based on a morphologic study of about 450 Clark nevi in nine patients, we classify Clark nevi dermoscopically into three types, namely, reticular, globular, and homogeneous [unpublished data]. Frequently, combinations of these types are found, the combination of reticular and globular types being the most common one.

The reticular type, by far the most common single type, is characterized by a more or less prominent pigment network with thin lines and regular meshes. The pigment network is usually evenly distributed throughout the lesion and fades out at the periphery (Fig. 1). The globular type is characterized by a dotted and/or globular pattern composed of numerous dots/globules of variable size and shape (oval, round or rectangular) more or less evenly distributed throughout the lesion. As already mentioned, the combination of the globular and reticular types is rather common. An interesting morphologic presentation of this combined pattern is a more or less annular arrangement of dots/globules at the periphery of an otherwise typical reticulated Clark nevus. The least frequent of the three major patterns of Clark nevi is the homogeneous one, characterized by a diffuse pigmentation of various shades of brownish coloration with only isolated reticular and/or globular areas.

Besides the three dermoscopic archetypes of Clark nevi, a number of rather characteristic dermoscopic variants have been noted and are, at least as we perceive it, basically due to a specific distribution of hypopigmentation or hyperpigmentation throughout the lesion, namely, central, multifocal, or peripheral. In this context four rather distinctive subtypes are described and illustrated as follows.

1. Clark nevus with central hypopigmentation: This is a variant of the reticular type with more or less centrally situated hypopigmented area almost devoid of other dermoscopic features displaying an annular appearance.

2. Clark nevus with central hyperpigmentation: This type, also called hypermelanotic nevus, represents a distinctive variant composed of a more or less broad rim of prominent pigment network lines at the periphery and a central, diffuse, irregularly outlined black hyperpigmentation, also called black lamella.
3. Clark nevus with multifocal hypo/hyperpigmentation: Basically, this type is just a variation on the theme of the reticular pattern with a multifocal hypopigmentation due to several, small, isolated hypopigmented areas, thus leading to an uneven distribution of the pigment network. Another variant of this type is characterized by multifocal zones of prominent, dark-brown to black pigmented network structures in a patchy distribution.
4. Clark nevus with peripheral hyperpigmentation: In our estimation, this type of Clark nevus is of the uppermost significance, because this group commonly encompasses melanoma in situ or even early invasive melanoma. Dermoscopically, this type has a reticular pattern with a prominent hyperpigmented, and sometimes also atypical pigment network. Certainly, this type of Clark nevus has to be excised.

Besides the three major patterns and the above mentioned modifications based on the distribution of hypopigmented and hyperpigmented areas, additional dermoscopic criteria may be occasionally found in Clark nevi, such as streaks and blue areas, to name but a few. Very rare milium-like cysts and comedo-like openings can be observed in the compound and dermal types of Clark nevi. According to Kreusch and Koch (16) a delicate vascular pattern characterized by the presence of comma and dotted vessels is rather common in Clark nevi.

3. Dermal Nevus (Unna and Miescher Nevus)

The term dermal nevus encompasses two clinical, dermoscopic and histopathologic rather distinctive variants of benign melanocytic nevi, namely, Unna nevus (papillomatous dermal nevus) and Miescher nevus (dermal nevus of the face).

Clinical features

Clinically, Unna nevus is a soft polypoid or sessile, usually papillomatous lesion frequently located on the trunk, arms, and neck. The clinical features of Miescher nevus are rather firm, brownish to nearly skin-colored, dome-shaped papules that occur mostly on the face (17).

The clinical features of these two common types of benign melanocytic nevi are often quite straightforward, allowing clinical diagnosis at a glance. Thus in many instances dermoscopic examination is superfluous. Nevertheless, the dermoscopic features of Unna and Miescher nevi are rather distinctive and are described here below.

Dermoscopic features

Dermoscopically, Unna nevi reveal a globular pattern composed of numerous light- to dark-brown, round to oval globules distributed regularly throughout the lesion, or a cobblestone pattern consisting of larger, somehow angulated globular structures. In addition, Unna nevi in some instances display densely packed exophytic papillary structures, which are commonly separated by irregular, black comedo-like openings also known as irregular crypts. These exophytic papillary structures correspond to an exaggeration of the papillomatous surface of an Unna nevus.

In contrast to Unna nevi, the surface of Miescher nevi is clinically as well dermoscopically smooth and, as a rule, does not reveal these exophytic papillary structures. Miescher nevi are dermoscopically characterized by a so-called pseudonetwork with round, equally sized meshes corresponding to pre-existing follicular openings. When appearing as skin-colored nodules Miescher nevi reveal numerous comma-like vessels especially at the periphery, which allow the distinction from nodular basal cell carcinoma to be made with confidence. Sometimes, milia-like cysts and comedo-like openings are also detected dermoscopically. The latter ones can be observed clinically by experienced clinicians and represent a subtle clue for differentiation between dermal nevi and nodular basal-cell carcinoma on the face.

4. Spitz and Reed Nevi

Spitz nevi as well as Reed nevi are well-known simulators of cutaneous melanoma from a clinical, dermoscopic, and histopathologic point of view.

Clinical features

The clinical features of Spitz nevi are protean; they may present as small, well-circumscribed, reddish papules (classical Spitz nevus), larger reddish plaques, small dark-brown to black papules, larger, rather well-circumscribed, jet-black plaques (Reed nevus) but also as verrucous plaques with variegated colors. Because of these clinical features Spitz nevi as well as Reed nevi are often difficult to differentiate from melanoma by clinical criteria alone. Although Spitz nevi occur mostly in individuals younger than 20 years of age, they may be rarely found also in the third and fourth decades.

Dermoscopic features

Specific dermoscopic criteria have been described in order to differentiate these nevi from melanoma, thus increasing diagnostic accuracy for pigmented Spitz nevi from 56% to 93% (18). Dermoscopically, about 50% of pigmented Spitz nevi show a symmetric appearance and a characteristic starburst pattern. This is typified by a prominent, gray-blue to black diffuse pigmentation, and by streaks located regularly at the periphery in a stellate or radiate distribution (Fig. 2). A characteristic dermoscopic finding is a central, bizarre or reticular black-whitish to blue-whitish veil, formerly called also reticular depigmentation and negative pigment network. In some examples, a regular and prominent pigment network may be detected. Only a prominent black-blue pigmentation, with no streaks at the periphery, can be more rarely observed.

Histopathologically, most of the lesions showing the starburst pattern exhibit the morphologic features of pigmented spindle-cell nevus (Reed nevus), namely, symmetric and well-circumscribed proliferation of spindle-shaped melanocytes arranged in nests closely packed along the dermo-epidermal junction. In addition, numerous melanophages are present in the papillary dermis immediately beneath the nests of melanocytes.

By dermoscopic examination a second group of pigmented Spitz nevi (about 25% of cases) reveal a symmetric, basically globular pattern with a regular, discrete, brown to gray-blue pigmentation in the center, and a characteristic rim of large brown globules at the periphery. Brown to gray-blue globules and dots may also extend throughout the lesion. In less pigmented Spitz nevi a dotted vascular pattern may be detected.

The histopathologic correlates of the lesions showing the globular pattern are those of a stereotypical Spitz nevus (spindle- and/or epithelioid-cell nevus). Typically, these tumors display a symmetric silhouette and sharp circumscription with striking nests of spindle and/or large epithelioid cells involving the epidermis and/or the papillary and reticular dermis. Maturation of melanocytes (gradual diminution of nuclear and cellular sizes) with progressive descent into the dermis is a constant finding, whereas necrotic cells and mitotic figures are only occasionally found. The latter morphologic features, however, cannot be seen dermoscopically.

A third group of pigmented Spitz nevi (25% of cases) may exhibit an atypical dermoscopic appearance characterized by an uneven distribution of colors and structures. The majority of these cases show an irregular, diffuse, gray-blue pigmentation resembling a blue-whitish veil which represents a specific dermoscopic criterion for the diagnosis of melanoma. Pigment network, brown globules, black dots, and depigmented areas as well as the streaks at the periphery may also be irregularly distributed. Occasionally, a dotted vascular pattern may be observed. Despite the atypical dermoscopic appearance of these Spitz nevi, the preoperative diagnosis may be in favor of a benign lesion because of the clinical constellation, namely, a given pigmented skin lesion occurring in children and showing no history of growth.

Remarkably, melanoma may rarely display either the starburst or the globular pattern seen in pigmented Spitz/Reed nevi. Therefore, surgical excision and subsequent histopathologic examination should be performed in pigmented skin lesions revealing the characteristic dermoscopic features of Spitz/Reed nevi, especially when arising in adult patients or showing a history of recent change in color, shape, or size (19).

5. Blue Nevus

Blue nevi are considered to be congenital lesions, albeit most of them are acquired in the sense that they are not apparent clinically at birth. Blue nevi commonly reveal clinical and especially dermoscopic features that are morphologically distinctive and allow a clinical diagnosis to be made with a high degree of certainty. In rare instances, however, blue nevi, especially when nodular, may be simulators of cutaneous melanoma from a clinical as well as a dermoscopic point of view. More important than this set of false-positive cases (clinically overdiagnosed melanomas) is the group of melanomas that are not excised because of the clinical and/or dermoscopic diagnosis of blue nevus, thus representing false-negative cases (underdiagnosed melanomas).

Clinical features

Clinically, blue nevi appear as relatively regular, sharply circumscribed, monomorphous macules, papules, plaques or nodules with a uniform brownish-blue, blue to gray-blue or sometimes even gray-black pigmentation. Clinical variants of blue nevus, also referred to as diffuse melanocytoses, are the nevus of Ota and Ito that appear many years after birth on the face and on the trunk, respectively, and the so-called Mongolian spot over the sacrum that is present at or near birth. A less common type of blue nevus is the neuronevus blue Masson, clinically characterized as a gray to blue deep-seated nodule, usually situated on the buttocks, and involving the entire reticular dermis with extension to the subcutaneous fat.

Dermoscopic Features

Dermoscopically, blue nevi exhibit a homogeneous pattern with complete absence of local features, such as pigment network structures, brown globules or black dots within the diffuse homogenous pigmentation (Fig. 3). This absence of local features and the presence of a well-defined border, usually without streaks, are criteria to differentiate blue nevus from melanoma, in many cases with a high degree of certainty. In some instances, however, the differential diagnosis between blue nevus and nodular melanoma is also dermoscopically difficult as identical dermoscopic findings may be present in both neoplasms. A rather uncommon dermoscopic finding

in blue nevi is the presence of diffuse hypopigmentations corresponding to more or less pronounced areas of collagenization in the reticular dermis of a fibrosing type of blue nevus. The nearly complete absence of local features within the homogeneous pigmentation of a blue nevus can be easily explained from a histopathologic standpoint by the fact that virtually all blue nevi are situated mostly within the dermis with a small 'grenz zone' immediately beneath the epidermis.

6. Congenital Nevus

Congenital nevi are benign melanocytic skin neoplasms already present at birth or arising during the first weeks (or months) of life. Congenital nevi are well known precursor lesions of melanoma, the reported risk of development of melanoma ranging from 5% to 10%, presumably depending on the size of the lesion.

Clinical features

Congenital nevi generally appear as flat or elevated, light-brown to dark-brown lesions. The surface can be smooth, cribriform, papillated or verrucous. Numerous hairs are often present within a lesion, the nevus then being commonly called hairy nevus. A particular clinical dilemma is the so-called congenital pseudomelanoma, a type of congenital nevus characterized by several to numerous, roundish to oval, dark-brown or black pigmented areas within an otherwise stereotypical congenital nevus clinically simulating a melanoma within a pre-existing congenital nevus (20). Attempts have been made to classify congenital nevi according to size, e.g., less than 1.5 cm for small congenital nevi, more than 1.5 cm to 20 cm for intermediate congenital nevi, and 20 cm or more for large congenital nevi. Recently, Ackerman provided a new classification of congenital nevi subdividing them in blue nevi and non-blue nevi. The latter, in turn are grouped into superficial and deep congenital melanocytic nevi, based on localization of melanocytes/nevus cells in the dermis, as judged by conventional microscopy. The stereotype of the superficial congenital nevus is nevus spilus (congenital speckled lentiginous nevus) while that of the deep type is the so-called giant hairy nevus (15).

Dermoscopic features

The dermoscopic assessment of congenital nevi is difficult, not only because in large congenital nevi the practical application of dermoscopy is somehow burdensome, but also because their dermoscopic features are protean.

The global features of congenital nevi are the cobblestone, globular or often the multicomponent pattern. As for local features, typical pigment network structures with slight variations on the theme may be found. Moreover, many variously sized dots and globules with different shades of brown and black are very often distributed more or less regularly throughout the lesion. Due to the many follicular openings in congenital nevi, localized multifocal hypopigmentation is commonly present, particularly around the pre-existing follicular ostia. An even more relevant dermoscopic finding is the occurrence of localized regular zones of hyperpigmentation corresponding to clusters of heavily pigmented melanocytes/nevus cells, a rather common histopathologic finding in congenital nevi. This particular dermoscopic finding can also be clearly appreciated clinically and represents the clinical and dermoscopic hallmark of congenital pseudomelanoma, as mentioned above. Furthermore, congenital nevi of the verrucous type are characterized by peculiar dermoscopic features reminiscent of seborrheic keratosis, namely, comedo-like openings, irregular crypts and milia-like cysts as well as an opaque brown-yellowish coloration due to the pronounced orthohyperkeratosis. Small congenital melanocytic nevi are often clinically as well as dermoscopically similar to Clark nevi and cannot be differentiated at all on the basis of clinical findings.

7. Lentigo

Lentigo refers to a small, brownish macule that can be observed in various clinical settings thus having different implications with regard to the management of patients bearing one or more lentigines. Dealing with the dermoscopic examination of pigmented skin lesions, only three types of lentigines will be discussed in detail, namely, lentigo simplex, lentigo reticularis and solar lentigo.

At least in our estimation, lentigo maligna is nothing but a variant of melanoma in situ on severely sun-damaged skin and will be considered under melanoma.

Lentigo simplex

Lentigo simplex is an extremely common, benign melanocytic skin lesion, which can be regarded as the precursor lesion of acquired junctional melanocytic nevus, nowadays called Clark nevus.

Clinical features

Clinically, lentigo simplex involves sun-exposed skin of the trunk and extremities in individuals with white complexion. They usually appear as small, sharply demarcated macules about 3-5 mm in diameter displaying a uniform light-brown or dark-brown color.

Dermoscopic features

Dermoscopic examination of a lentigo simplex is rarely performed, since clinical appearance in conjunction with the clinical setting is virtually diagnostic. When performing dermoscopy, one may observe a delicate, typical pigment network with regularly sized meshes distributed evenly throughout the lesion corresponding to elongated and moderately pigmented rete ridges.

Reticulated lentigo

In 1992 Bologna described a darkly pigmented type of actinic lentigo, clinically simulating melanoma in situ, in a series of patients with Celtic ancestry and numerous actinic lentiginosities and proposed the term "reticulated black solar lentigo (ink spot lentigo)" (21). Furthermore, she pointed out that these lesions were of concern to patients and primary care physicians, because of their dark color and irregular border.

Clinical features

The clinical setting of reticulated lentigo is rather stereotypical, because the lesion is nearly exclusively restricted to white individuals with skin type I or II and a history of severe sunburns with blister formation. As a rule, the reticulated lentigo is surrounded by numerous sun-induced

freckles. It is usually situated on the back and occurs as a solitary black lesion with wiry or beaded, markedly irregular outline thus clinically simulating melanoma in situ.

Dermoscopic features

Dermoscopically, the reticulated lentigo reveals a distinctive appearance, characterized by a bizarre and asymmetric reticular pattern with markedly thickened pigment network showing irregular and wide meshes. This pathognomonic dermoscopic appearance reflects the particular epidermal architecture marked by pronounced pigmentation of the tips of elongated rete ridges and by the nearly complete absence of epidermal pigmentation covering the suprapapillary plates.

Solar lentigo

Solar lentigo (Synonyms: lentigo actinica, senile lentigo) is a circumscribed, brownish macule occurring usually as numerous lesions on chronically sun-damaged skin. Solar lentigo may be regarded as the precursor lesion of the reticulated type of seborrheic keratosis, because of the frequent association of these two pigmented skin lesions on clinical and histopathologic grounds.

Clinical features

Clinically, solar lentigines usually occur as numerous lesions on severely sun-damaged skin in elderly individuals, but may even develop in the first decades of life. They are mainly found on the dorsum of hands, extensor surfaces of the forearms, and the face. The lesions may vary in size up to a few cm in diameter and are characterized by markedly irregular outlines with various shades of coloration ranging from light-brown to dark-brown.

Dermoscopic features

As mentioned before in the context of lentigo simplex, the clinical diagnosis of solar lentigo is very easy in most instances and dermoscopic examination not really necessary. In our opinion, dermoscopic examination of solar lentigines is nevertheless helpful in order to better understand the differential diagnostic difficulties that may arise with melanoma in situ on severely sun-damaged skin. Dermoscopically, solar lentigines on the dorsum of the hands, extensor surfaces of the arms, and the back, reveal a delicate, sharply demarcated reticular pattern with regular meshes and thin

lines. The dermoscopic appearance of solar lentigines on the face, however, is complicated by the particular anatomy of facial skin. In some instances a classical pseudonetwork and a delicate pigment network inherent to solar lentigo may be found closely associated. More frequently, a homogeneous pattern is combined with a delicate, light-brown, typical pseudonetwork. In other instances so-called "moth-eaten edge" is recognizable as a non-uniform concave area resembling a "bite" at the periphery of a lesion (22).

8. Labial and Genital Melanosis

Melanosis of oral and genital mucosae (labial lentigo, lentiginosis of oral mucosa, genital lentiginosis) are benign melanotic macules characterized by single or often numerous lesions with a tendency to confluence. Despite its benign behavior, the clinical aspect of melanosis on each of the above mentioned anatomic sites (oral mucosa; lower lip; vulva and penis) may frequently share features with melanoma in situ. In all these instances a punch biopsy with subsequent histopathologic examination is crucial in order to positively rule out melanoma in situ. Although melanotic macules are regarded by most clinicians as wholly benign lesions mimicking melanoma in situ only from a clinical standpoint, some dermatologists also consider these melanotic macules as precursor lesions of melanoma (23). At present, results of prospective, large-scale studies focusing on patients with genital and oral lentiginosis are not available to predict the natural history of genital and oral lentiginosis or its relation to mucocutaneous melanoma.

Clinical features

Clinically, labial lentigo is usually situated on the lower lip and appears as a roundish, well circumscribed, light-brown macule. In contrast to the solitary labial lentigo, melanosis of the male and female genitalia is characterized by numerous, multifocal, relatively large (up to 2 cm), irregularly outlined macules with a variegated brownish pigmentation displaying a speckled pattern. Commonly they were regarded as having an atypical clinical appearance and at least close clinical follow-up examinations or, even better, punch biopsies are recommended.

Dermoscopic features

A practical problem, especially when examining melanosis of the vulva and the penis, is the close working distance when using the conventional dermatoscope. Nevertheless, the dermoscopic features of melanosis on both oral and genital locations are rather characteristic, revealing diffuse pigmentation with a peculiar parallel pattern of partially linear and partially curvilinear light-brown to dark-brown streaks. Furthermore, based on our experience, melanoma-specific criteria such as atypical pigment network variations, irregular dots/globules and blue-whitish veil have not been found in benign labial and genital melanosis.

9. Basal Cell Carcinoma

Basal-cell carcinoma (BCC) is generally considered to be the most common primary malignant neoplasm in humans. Since they grow exceedingly slowly, most BCCs are innocuous, but if left untreated they can cause extensive destruction of tissue locally, and may lead to death by infiltrating and destroying vital structures.

Clinical features

Predicated on clinico-pathologic correlations, BCC can be basically divided into four distinctive types, namely nodular, superficial, morpheiform, and fibroepithelial (so-called fibroepithelial tumor of Pinkus). From a clinical point of view, nodular BCC occurs commonly on the face as a firm, "pearly" papule or nodule whose surface is covered by telangiectases. In time, the dome-shaped lesions tend to become eroded and then ulcerated. BCCs may occasionally be heavily pigmented due to the presence of melanin within aggregations of basaloid cells thus clinically resembling melanomas.

Dermoscopic features

Dermoscopy is usually performed only in pigmented skin tumors. However, since the dermoscopic hallmark of pigmented BCC, namely, the presence of arborizing vessels, can be appreciated even better in non-pigmented nodular BCC, we recommend dermoscopic examination of these lesions, especially when the differentiation from squamous-cell carcinoma and

keratoacanthoma on clinical grounds alone is difficult. The latter ones are characterized by hairpin vessels surrounded by a whitish halo (dermoscopic sign of keratinization) and dotted vessels, whereas BCC nearly exclusively displays arborizing vessels (16). Pigmented BCC is commonly characterized by a multicomponent or globular pattern. Besides the pathognomonic vascular pattern consisting of vessels with different diameters and numerous branches, leaf-like areas with an opaque gray-brown to slate-gray pigmentation, mostly situated at the periphery of the lesion, represent an additional dermoscopic clue for the diagnosis of BCC (Fig. 4). However, only blue-gray globules and/or blue-gray ovoid structures are sometimes visible. In conjunction with the complete absence of other dermoscopic melanoma-specific criteria, these gray structures lead to the diagnosis of BCC (24).

10. Seborrheic Keratosis

Seborrheic keratosis is a benign, exceedingly common epithelial skin neoplasm and most individuals will develop one or even numerous of them during their lifetime.

Clinical features

Seborrheic keratoses appear on any body site except palms and soles, but are most frequent on the face and the trunk. They usually begin as flat, sharply demarcated, brown macules and usually evolve within a solar lentigo. Later on, seborrheic keratosis may become polypoidal with an uneven, papillated surface. From a clinical standpoint, seborrheic keratoses typically have a "stuck on" appearance with a verrucous and dull surface. Their coloration varies from dirty yellowish to opaque brownish-black. Follicular prominence is one of the clinical hallmarks. Although the clinical diagnosis of most seborrheic keratoses can be made easily at a glance, in some instances, due to its many clinical facets even experienced clinicians may have diagnostic problems.

Dermoscopic features

The dermoscopic features of each of the three major types of seborrheic keratosis, namely, acanthotic, reticulated and verrucous, are different and rather distinctive.

Acanthotic type

The dermoscopic hallmark of acanthotic seborrheic keratosis are few to numerous milia-like cysts and several comedo-like openings (Fig. 5), the latter sometimes resembling the so-called irregular crypts. The background coloration varies from an opaque light-brown to dark-brown or even black pigmentation. In about 50% of acanthotic seborrheic keratoses, a vascular pattern exhibiting hairpin vessels and dotted vessels can be appreciated. In lesions showing papillations upon clinical examination, exophytic papillary structures are observed dermoscopically. As a rule, in the acanthotic type of seborrheic keratosis there is no pigment network, but small foci of a fine, delicate pigment network may be evident at the periphery. Another morphologic finding that is sometimes observed in evolving acanthotic seborrheic keratosis is a global pattern resembling the surface of the brain, and the underlying dermoscopic structures are therefore called gyri and sulci.

The dark-brownish gyri as well as irregular crypts and comedo-like openings are basically nothing but keratin plugs within variously shaped indentations of a more or less acanthotic seborrheic keratosis. The yellowish to light-brownish lines between gyri are called sulci or fissures and are arranged reciprocal to the gyri, thus giving rise to the peculiar 'brain-like' appearance.

Two variations on the theme of acanthotic seborrheic keratosis may aggravate the dermoscopic diagnosis:

1. melanoacanthoma variant with a pronounced black pigmentation camouflaging the pathognomonic local features;
2. irritation with variously sized and shaped scale-crusts masking the diagnostic features.

Reticulated type

The reticulated type of seborrheic keratosis is characterized by a reticulated pattern that on the face is combined with the site-specific pseudonetwork. This frequently causes diagnostic difficulties in the differentiation from melanoma in situ on severely sun-damaged skin (lentigo maligna).

Keratotic type

The keratotic type of seborrheic keratosis basically has an unspecific dermoscopic pattern. Because of the exaggerated orthohyperkeratosis, local features are not visible and therefore the dermoscopic examination only reveals whitish to yellowish horn masses.

11. Vascular Lesions (Including Hemorrhages)

The dermoscopic examination of vascular lesions, including hemorrhages due to trauma, is of paramount relevance, because melanomas can be excluded with a high level of certainty. The following entities will be discussed in detail: hemangioma, angiokeratoma, subungual hemorrhage, and subcorneal hemorrhage.

From a dermoscopic point of view the lowest common denominator of all these lesions is their reddish, reddish-blue, to reddish-black coloration in the complete absence of pigment network structures and other melanoma-specific criteria.

Hemangioma

The term hemangioma comprises various solitary vascular proliferations, such as arteriovenous hemangioma (cirroid aneurysm), capillary aneurysm (thrombosed capillary aneurysm), cherry angioma (senile angioma), pyogenic granuloma, and venous lake, that may occasionally simulate a melanoma and therefore are often examined dermoscopically. Solitary lymphangioma is also mentioned here, since its dermoscopic features are basically identical with the so-called hemangioma group. Classic capillary and cavernous hemangiomas, commonly found in neonates, are not considered here, because the lesions are diagnosed clinically and dermoscopic examination is usually not performed.

Dermoscopically, the lesions reveal a typical lacunar pattern, although in some instances, e.g. venous lake or pyogenic granuloma, the lacunar pattern cannot be easily recognized. Actually, venous lake more often has a homogeneous pattern and pyogenic granuloma may show a multicomponent pattern. The dermoscopic hallmark of the hemangioma group is the presence of several to numerous, roundish or oval areas with a reddish or red-bluish coloration. These red

lacunas (also called red lagoons) are virtually pathognomonic for hemangiomas. Since the underlying histopathologic substrate is often situated in the superficial dermis and not immediately beneath the epidermis, as in angiokeratoma, these lacunas are not really sharply circumscribed.

Angiokeratoma

The term angiokeratoma encompasses several, unrelated conditions characterized by the combination of vascular proliferations and hyperkeratosis. The different types of angiokeratomas are the following: solitary angiokeratoma, angiokeratoma circumscriptum, angiokeratoma of Fordyce (angioma of scrotum and vulva), angiokeratoma of Mibelli, and angiokeratoma corporis diffusum (Fabry's disease). With regard to dermoscopy of pigmented skin lesions only solitary angiokeratoma is pertinent.

From a clinical point of view, the solitary angiokeratoma is a small, warty, red-blue to black papule that may appear on any anatomic site with predilection of the lower extremities. It can be regarded as a 'pseudomelanoma', since it simulates melanoma clinically.

Dermoscopically, solitary angiokeratoma is characterized by a lacunar or multicomponent pattern composed of large, several to numerous, sharply demarcated, roundish or oval areas with a reddish, red-bluish or dark-red to black coloration. These red lacunas are very distinctive and together with whitish-yellowish keratotic areas are diagnostic for angiokeratomas (Fig. 6). Another dermoscopic feature frequently found in angiokeratoma is the presence of a whitish veil due to the acanthotic epidermis with hypergranulosis and compact orthokeratosis. Since this whitish veil is not associated with any pigment network or any other melanoma-specific criteria, it is not considered in the diagnostic algorithm at all. Not infrequently is a reddish halo found around an angiokeratoma as a consequence of recent trauma.

Subungual Hemorrhage

Nail hemorrhage frequently occurs following trauma to the nail. Obviously, the extent of such a subungual hemorrhage depends on the intensity and force of the trauma. However, patients

seeking the advice of a physician because of subungual hemorrhage never recall any trauma or even think of the possibility of a trauma, because otherwise they would not seek consultation.

The main clinical differential diagnoses of subungual hemorrhages are subungual nevi, subungual melanomas and, rarely, infections with fungi or bacteria, e.g. pseudomonas. Clinically, subungual hemorrhages are characterized by variously sized, round to oval, sharply circumscribed, usually jet-black areas.

Interestingly enough, at dermoscopic examination the jet-black clinical pigmentation appears lighter and reveals a red-black or even dark-red color, suggestive of hematoma. Moreover, adjacent to the sharply demarcated, structureless, dark red areas, some tiny, roundish, reddish dots may be recognized that on clinical examination are not visible. Moreover, in some instances the nail plate overlying the subungual hematoma shows a slight roughness upon dermoscopic examination.

Subcorneal Hemorrhage

Subcorneal hemorrhage, also called black heel, talon noir or subcorneal hematoma, is seen commonly on the heels of young individuals involved in sport activities such as tennis, basketball or soccer. Of course, it is also found on the palms, resulting from lateral forces due to other sport activities, e.g. tennis, golf or mountain climbing. As is the case with subungual hemorrhage, individuals seeking medical advice never ever recall any trauma. Within a few weeks, or within a few months when the soles are involved, subcorneal hemorrhage resolves spontaneously.

Clinically, subcorneal hemorrhage represents an asymptomatic sharply circumscribed, homogeneous, red-black to jet-black macule. As is the case with subungual hemorrhage, the reddish coloration of subcorneal hemorrhage can be much better appreciated when performing dermoscopy, which allows a reliable diagnosis to be made in most instances.

Although the global pattern is usually homogeneous or globular, in some cases the pigmentation is more pronounced and follows the cristae of the glabrous skin, revealing a somewhat parallel pattern. A nearly similar parallel pattern, called 'parallel ridge pattern', however, has recently been described in acral melanoma in situ by Oguchi et al. (11), whereas in acral nevi the

parallel pattern following the sulci of glabrous skin is named 'parallel furrow pattern'. So, even when using dermoscopy, at least in rare cases, the differentiation between subcorneal hemorrhage on the one hand and acral melanoma in situ on the other hand may be difficult and a punch biopsy with subsequent histopathologic examination may be necessary.

12. Dermatofibroma

Dermatofibroma (fibroma durum, fibrous histiocytoma, histiocytomas, nodular subepidermal fibrosis, sclerosing hemangioma) is a very common benign skin lesion occurring anywhere on the body surface with predilection for the extremities, especially the lower legs. The cause of a dermatofibroma is unknown, but responses to injuries, both external, e.g., insect bites, and internal, e.g., ruptured follicles, have been considered.

Clinical features

Clinically, dermatofibromas appear as firm, single or multiple papules, plaques or nodules usually characterized by a color variable from light-brown to dark-brown, purple, red or yellow. Dermatofibromas range from 0.5 mm to 1 cm in diameter. They are usually indolent, sometimes pruritic and may ulcerate. Characteristically, dermatofibromas are hard and freely movable over deeper tissue and lateral compression can produce a dimple-like depression in the overlying skin. An important clinical differential diagnosis is with dermatofibrosarcoma protuberans, especially in unusually large dermatofibromas. Other differential diagnoses include blue nevi and, first of all, melanomas.

Dermoscopic features

Dermatofibroma is probably the only entity within the spectrum of pigmented skin lesions where palpation is of diagnostic relevance. This fact should be kept in mind when judging only the dermoscopic image of a given dermatofibroma. Nevertheless, the dermoscopic features of dermatofibroma are fairly characteristic and in most instances allow a definitive diagnosis with a high degree of certainty. The global pattern of dermatofibroma is considered unspecific or, rarely, multicomponent, although a reticular pattern in an annular distribution can be easily observed in

many cases. In this context it should be mentioned that dermatofibromas and actinic lentiginos are the only non-melanocytic pigmented skin lesions revealing a pigment network. The dermoscopic hallmark of dermatofibroma is a more or less irregularly outlined, sharply demarcated central white patch surrounded by a delicate, regular, usually light-brown pigment network (25). Sometimes within the central white patch several, small, roundish to oval globules of light-brown coloration are found. Another finding in dermatofibroma might be a reddish halo around the lesion, presumably reflecting external injury.

II. GUIDE TO PATTERN ANALYSIS

The classic dermoscopic method for diagnosing pigmented skin lesions, called pattern analysis, was set forth by Pehamberger et al. in 1987 (1). In the following years other similar qualitative approaches have been elaborated by a few experts all over the world, namely, "Strukturanalyse" by Kreusch and Rassner (26), "Grading protocol" by Kenet et al. (7), and "Surface microscopy algorithm" by Menzies et al. (4). As proponents of the classic pattern analysis, we have modified this method. In our estimation each diagnostic category within the realm of pigmented skin lesions is characterized by a few global patterns and a rather distinctive combination of specific (common) local features. In some instances, however, additional (uncommon) local features might be observed, providing helpful diagnostic clues. A particular aspect of our approach is the so-called confounding feature, i.e. dermoscopic criteria that are infrequently present within a given diagnostic category, thus sometimes leading to false diagnoses. The knowledge of these confounding features will help avoid false-positive and, even more important, false-negative results. Table 3 summarizes the diagnostic criteria for pattern analysis as thoroughly explained in the previous pages.

III. ALTERNATIVE DIAGNOSTIC ALGORITHMS

Dermoscopy has recently proven to be a valuable method for improving the clinical diagnosis of melanoma. The classic approach for diagnosis in dermoscopy is the so-called pattern analysis. This widely used diagnostic method is based on a critical, simultaneous assessment of

individual dermoscopic criteria improving the rate of correct diagnosis of pigmented skin lesions by 10% to 30%. Nevertheless, because of problems inherent to the reliability and reproducibility of the diagnostic criteria used in pattern analysis, additional diagnostic methods based on diagnostic algorithms have been introduced in the last few years with the aim to increase sensitivity in detecting cutaneous melanoma.

For these methods, namely, the ABCD rule, the 7-point checklist, and the Menzies' method, a given pigmented lesion must first be classified as melanocytic or non-melanocytic. This melanocytic algorithm is shown in detail in Table 4. Only when the diagnosis of a non-melanocytic lesion is ruled out and a melanocytic lesion is diagnosed, can these methods be applied.

1. The ABCD rule of dermatoscopy is based on a semiquantitative analysis of the asymmetry, border, color, and different dermoscopic structures of a given melanocytic lesion (2,27). The ABCD rule was thought to be helpful also for clinicians not fully experienced in dermoscopic observation, being simpler than pattern analysis.
2. A new algorithm, called the 7-point checklist, providing a quantitative scoring system and a simplification of the classic pattern analysis due to the lower number of features to identify. This method was developed for the dermoscopic diagnosis of melanoma based on a blind evaluation of 342 melanocytic skin lesions (117 melanomas and 225 clinically atypical nevi) (3).
3. The Menzies' method for the diagnosis of melanoma (4) based on the recognition of two negative dermoscopic features (not favoring melanoma diagnosis) and nine positive features (favoring melanoma diagnosis).

ABCD Rule

The ABCD rule introduced by Stolz and coworkers (2) can be easily learned and rapidly calculated and has been proven to be a reliable method providing a more objective and reproducible diagnosis of melanoma. Also, in 1994, Nachbar et al. (27) proved the reliability of the ABCD rule in a prospective study. In 172 melanocytic lesions (69 melanomas and 103 melanocytic nevi)

specificity was 90.3% and sensitivity was 92.8%. One may argue, however, that the pretest probability with 69 melanomas out of 172 melanocytic lesions was much too high in this prospective study and does not reflect the real scenario even in a specialized pigmented skin lesion clinic.

The semiquantitative ABCD rule represents the second step of a two-step procedure that was originally proposed by Kreusch and Rassner in the German literature (28) and later modified by Stolz (29). First, a given pigmented lesion must be classified as melanocytic or non-melanocytic. Only when the diagnosis of a non-melanocytic lesion is ruled out and a melanocytic lesion is diagnosed, can the ABCD rule be applied, at least following Stolz' instructions.

For calculating the ABCD score the 'asymmetry, border, color, and differential structure' criteria have to be assessed semiquantitatively. Then, each of the criteria has to be multiplied by a given weight factor yielding a total dermatoscopy score (TDS). TDS values less than 4.75 indicate a benign melanocytic lesion, values between 4.8 and 5.45 indicate a suspicious lesion and values greater than 5.45 are highly suspicious for melanoma. In particular anatomic locations, such as palms/soles, lips and genital region, the calculation of the ABCD score does not provide reliable results (Table 5).

Detailed explanation for calculating the ABCD score

Asymmetry

A given melanocytic lesion is bisected by two 90° axes that were positioned to produce the lowest possible asymmetry score. If both axes show dermoscopically asymmetric contours with regard to colors and differential structures, the asymmetry score is 2. If there is asymmetry on one axis the score is 1. If asymmetry is absent with regard to both axes the score is 0. Remarkably, most melanomas have an asymmetry score of 2 compared to about only 25% of benign melanocytic nevi. By using dermoscopy, asymmetry can be more precisely evaluated. Indeed, colors and structures are much better visible compared to the naked eye which, in most instances, allows assessment of asymmetry only by contour. Because of its high (1.3) weight factor, the assessment of asymmetry is

crucial for the final score and one should also keep in mind that in a strict sense 'nothing in nature is completely symmetric'.

Border

For semiquantitative evaluation, the lesions are divided into eighths and a sharp, abrupt cut-off of pigment pattern at the periphery within one eighth has a score 1. In contrast, a gradual, indistinct cut-off within one eighth has a score of 0. Therefore, the maximum border score is 8, and the minimum score is 0. As a rule the border score in nevi is very low and in melanomas is predominantly between 3 and 8. Because of its low weight factor (0.1) the border score is not very relevant, at least in our view.

Color

A total number of six different colors, namely, white, red, light-brown, dark-brown, blue-gray, and black, are counted for determining the color score. White should be only chosen if the area is lighter than the adjacent skin. When all six colors are present the maximum color score is 6; the minimum score is 1. Melanomas are usually characterized by three or more colors and in about 40% of melanomas even five or six colors are present. Remarkably, the color spectrum of melanocytic lesions is accentuated and intensified when performing dermoscopy.

Differential structure

The following five structural features have been selected by Stolz for evaluation of differential structures: pigment network, structureless or homogeneous areas, streaks, dots, and globules. Basically all these criteria have been explained in detail in step 2 of this course. Structureless or homogenous areas must be larger than 10% of the lesion. Streaks and dots are counted only when more than two are clearly visible. For counting a globule only the presence of one single globule is necessary. Again, the higher the number of these differential structures, the higher the probability of the lesion being a melanoma.

7-Point Checklist

In the original paper on the 7-point checklist (3) dermoscopic images of melanocytic skin lesions were studied to evaluate the incidence of 7 standard criteria. These features were selected for their frequent association with melanoma. Most of them were listed in the guidelines of the Consensus Meeting of Hamburg (30) and have been thoroughly described previously (Table 6).

The differences between melanomas and nevi were evaluated by a univariate statistical test and the significant variables were used for stepwise logistic regression analysis to determine their different diagnostic weight in the diagnosis of melanoma, as expressed by odds ratios. Using the odds ratios calculated with multivariate analysis, a score of 2 was given to the 3 criteria with odds ratios >5 , termed "major" criteria, and a score of 1 to the 4 criteria with odds ratios <5 , termed "minor" criteria. By a simple addition of the individual scores, a total score of 3 or more allowed classification for melanoma with a sensitivity of 95% and a specificity of 75%. In total 82% of melanocytic lesions were correctly diagnosed by the 7-point checklist method (Table 7).

The 7-point checklist is a diagnostic method that requires the identification of only 7 dermoscopic criteria, thus enabling even less experienced clinicians to use the model following a relatively short learning curve. In fact this simplified algorithm has been shown to be reproducible with non-expert dermatologists, who were able to classify a high percentage of melanomas (sensitivity range: 85-93%) (3). Of course the specificities rates of these non-experts were low (45-48%). This could be explained by the fact that most of the non-melanomas in the test set were clinically atypical, easily leading to the decision of performing a biopsy. Clearly, the true specificity of the method in the daily routine should be much greater.

In conclusion, for a melanoma to be diagnosed, the identification of at least 2 melanoma-specific dermoscopic criteria (1 major plus 1 minor or 3 minor criteria) is required.

Menzies' Method

In 1996 Menzies et al. proposed another alternative diagnostic method (4). This is an algorithm based on the recognition of two negative dermoscopic features (not favoring melanoma diagnosis) and nine positive features (favoring melanoma diagnosis). For a diagnosis of melanoma a lesion must not have either negative feature (symmetric pigmentation and a single color) and must have one or more of the nine positive features (Table 8). When used by experts, the Menzies method gave a sensitivity of 92% and a specificity of 71%. However, at the present time there is no study attesting to its reliability when used by less experienced dermoscopists.

Table 1 - Melanoma-specific criteria for melanoma in situ and early invasive melanoma (Breslow index <0.76 mm) according to the three main anatomic sites

Anatomic site	Criterion	Description	Frequency of criteria*
Trunk and extremities	Multicomponent pattern	Combination of three or more distinctive dermoscopic structures	Very common
	Atypical pigment network	Brown to black network with irregular meshes and thick lines	Very common
	Irregular dots/globules	Black, brown, and/or gray round to oval, variously sized structures irregularly distributed within the lesion	Common
	Irregular streaks	Irregular, more or less confluent, linear structures not clearly combined with pigment network lines	Common
	Irregular pigmentation	Black, brown, and/or gray pigmented areas with irregular shape and/or distribution	Common
	Regression structures	White areas (white scarlike areas) and blue areas (gray-blue areas, peppering, multiple blue-gray dots) may be associated, thus featuring so-called blue-whitish areas virtually indistinguishable from blue-whitish veil	Rather common
	Blue-whitish veil	Confluent, gray-blue to whitish-blue diffuse pigmentation associated with pigment network alterations, dots/globules and/or streaks	Uncommon
Face	Reticular pattern	Diffuse pigmentation of the epidermis or the papillary dermis in facial skin reveals a peculiar pattern, also called pseudonetwork, dermoscopically composed of round, equally sized meshes corresponding to pre-existing follicular ostia	Always present
	Atypical pigment pseudonetwork	This is typified by different morphologic aspects of the pseudonetwork due to the different steps of melanoma progression	Always present
	- Annular-granular structures	Multiple blue-gray dots surrounding the follicular ostia with an annular granular appearance	Common in the early phase
	- Gray pigment network	Gray pigmentation surrounding the follicular ostia formed by the confluence of annular-granular structures	Common
	- Rhomboidal structures	Gray-brown pigmentation surrounding the follicular ostia with a rhomboidal appearance	Common
	Irregular pigmentation	Black, brown, and/or gray pigmented areas with irregular size and shape, unevenly distributed throughout a lesion	Rather common, not in early phase
	Irregular dots/globules	Black, brown, and/or gray round to oval, variously sized and shaped structures irregularly distributed within the lesion	Rather common
Palms and soles	Parallel-ridge pattern	Pigmentation aligned along the cristae superficiales. It has to be differentiated from parallel-furrow pattern following the sulci superficiales (common finding in acral nevi)	Very common
	Irregular dots/globules	Black, brown, and/or gray round to oval, variously sized structures irregularly distributed within the lesion	Common
	Irregular pigmentation	Black, brown, and/or gray pigmented areas with irregular size and shape and uneven distribution	Common
	Irregular streaks	Irregular, more or less confluent, linear structures not clearly combined with pigment network lines	Rather common
	Blue-whitish veil	Confluent, gray-blue to whitish-blue diffuse pigmentation associated with pigment network alterations, dots/globules and/or streaks	Uncommon

(*) Very common: >70%; common: 50-70%; rather common: 30-50%; uncommon: <30%

Table 2 - Melanoma-specific criteria for intermediate and thick melanomas (Breslow index >0.75 mm)

Criteria	Description	Frequency of criteria*
Blue-whitish veil	Confluent, gray-blue to whitish-blue diffuse pigmentation associated with pigment network alterations, dots/globules and/or streaks	Very common
Irregular dots/globules	Black, brown, and/or gray round to oval, variously sized structures irregularly distributed within the lesion	Common
Irregular pigmentation	Black, brown, and/or gray pigmented areas with irregular size and shape, unevenly distributed	Common
Irregular streaks	Irregular, more or less confluent, linear structures not clearly combined with pigment network lines	Common
Atypical pigment network	Brown to black network with irregular meshes and thick lines	Rather common
Vascular pattern	Dotted, linear irregular, and/or hairpin vessels	Rather common
Regression structures	White areas (white scarlike areas) and blue areas (gray-blue areas, peppering, multiple blue-gray dots) may be associated, thus featuring so-called blue-whitish areas virtually indistinguishable from blue-whitish veil	Uncommon

(*) Very common: >70%; common: 50-70%; rather common: 30-50%; uncommon: <30%

Table 3 - Diagnostic criteria for pattern analysis as thoroughly explained in the text

Diagnosis	Global Patterns	Common Local Features	Uncommon Local Features	Confounding Features
Melanoma	<u>Common:</u> multicomponent <u>Uncommon:</u> reticular, globular, parallel-ridge, unspecific	Atypical pigment network, irregular dots/globules, irregular streaks, blue- whitish veil, irregular pigmentation, regression structures, dotted or linear irregular vessels	Hypopigmented areas, hairpin vessels	Homogeneous or starburst pattern; typical pigment network, regular dots/globules, regular streaks, milium-like cysts
Clark nevus	<u>Common:</u> reticular, globular <u>Uncommon:</u> homogeneous	Typical pigment network, regular dots/globules, regular pigmentation, hypopigmented areas	Regular streaks, regression structures	Multicomponent pattern; atypical network, irregular dots/globules, irregular streaks, irregular pigmentation, dotted vessels
Unna/Miescher nevus	<u>Common:</u> globular, cobblestone <u>Uncommon:</u> reticular, homogeneous, unspecific	Regular dots/globules, exophytic papillary structures, typical pseudonetwork, comma vessels	Comedo-like openings, milium-like cysts	Multicomponent pattern; irregular pigmentation
Spitz/Reed nevus	<u>Common:</u> starburst, globular <u>Uncommon:</u> multicomponent	Regular streaks, regular diffuse pigmentation, reticular blue-whitish veil, regular dots/globules	Dotted vessels, typical pigment network	Reticular pattern; atypical network, irregular dots/globules, irregular streaks, irregular pigmentation
Blue nevus	Homogeneous	Regular diffuse pigmentation	Hypopigmented areas	Irregular diffuse pigmentation, arborizing vessels
Congenital nevus	Cobblestone, globular, reticular, multicomponent	Regular dots/globules, typical network, multifocal hypopigmentation, regular pigmentation	Milium-like cysts, comedo-like openings, exophytic papillary structures	Localized irregular pigmentation, regression structures
Lentigo	Reticular	Typical network or pseudonetwork, regular diffuse pigmentation	Milium-like cysts	Atypical network, irregular pigmentation
Labial/genital melanosis	Unspecific, parallel	Regular pigmentation, typical network	Regular streaks	Atypical network, irregular pigmentation
Basal cell carcinoma	Unspecific, multicomponent	Leaf-like areas, irregular blue-gray globules, arborizing vessels	Milium-like cysts, hairpin vessels	Irregular gray-bluish pigmentation
Seborrheic keratosis	Unspecific, homogeneous, reticular	Milium-like cysts, comedo- like openings, exophytic papillary structures, regular pigmentation, hairpin vessels	Typical network, hypopigmented areas, dotted vessels, gyri and sulci, yellowish horn masses	Multicomponent pattern; irregular pigmentation, regression structures, irregular dots/globules
Vascular lesions	<u>Common:</u> lacunar <u>Uncommon:</u> homogeneous	Red lacunas, diffuse or localized structureless reddish-black to reddish- blue pigmentation	Parallel pattern, regular dots/globules, whitish-yellowish keratotic areas	Multicomponent pattern; irregular dots/globules, whitish veil
Dermatofibroma	<u>Common:</u> reticular <u>Uncommon:</u> unspecific, multicomponent	Annular pigment network, central white patch	Localized pigmentation or crusting, regular dots/globules, erythema	Irregular white areas

Table 4 – Algorithm for differentiating melanocytic from non-melanocytic pigmented skin lesions

Dermoscopic criteria	Diagnostic significance
Pigment network (also present in solar lentigo and seborrheic keratosis on facial skin) Brown to black dots/globules Streaks Homogeneous blue pigmentation (dermoscopic hallmark of blue nevus) Parallel pattern (on palms and soles)	Melanocytic lesion
Milia-like cysts Comedo-like openings (irregular crypts)	Seborrheic keratosis
Leaf-like areas Arborizing vessels Irregular gray-blue globules and blotches	Basal cell carcinoma
Red lacunas Red-bluish to red-black homogeneous areas	Vascular lesions (Including hemorrhages)
Central white patch surrounded by delicate pigment network	Dermatofibroma
None of the above criteria	Melanocytic lesion

Table 5 - ABCD rule of dermoscopy (Modified according to Stolz 1994) (2)

Criterion	Description	Score	Weight factor
Asymmetry	In 0, 1, or 2 axes; assess not only contour, but also colors and structures	0-2	X 1.3
Border	Abrupt ending of pigment pattern at the periphery in 0-8 segments	0-8	X 0.1
Color	Presence of up to six colors (white, red, light-brown, dark-brown, blue-gray, black)	1-6	X 0.5
Differential structures	Presence of network, structureless or homogeneous areas, streaks, dots, and globules	1-5	X 0.5
Total Dermoscopy Score (TDS)	Interpretation		
<4.75	Benign melanocytic lesion		
4.8-5.45	Suspicious lesion; close follow-up or excision recommended		
>5.45	Lesion highly suspicious for melanoma		
False-positive score (>5.45) sometimes observed in:	<ul style="list-style-type: none"> - Reed and Spitz nevus - Clark nevus with globular pattern - Congenital melanocytic nevus - Melanocytic nevus with exophytic papillary structures 		

Formula for calculating TDS:

$$[(A \text{ score} \times 1.3) + (B \text{ score} \times 0.1) + (C \text{ score} \times 0.5) + (D \text{ score} \times 0.5)]$$

Table 6 - The 7-point checklist: Definition and histopathologic correlates of the 7 melanoma-specific dermoscopic criteria

Criterion	Definition	Histopathologic correlates (31,32)
1. Atypical pigment network	Black, brown, or gray network with irregular meshes and thick lines	Irregular and broadened rete ridges
2. Blue-whitish veil	Confluent, gray-blue to whitish-blue diffuse pigmentation associated with pigment network alterations, dots/globules and/or streaks	Acanthotic epidermis with focal hypergranulosis above sheets of heavily pigmented melanocytes in the dermis
3. Atypical vascular pattern	Linear-irregular or dotted vessels not clearly combined with regression structures and associated with pigment network alterations, dots/globules and/or streaks	Neovascularization
4. Irregular streaks	Irregular, more or less confluent, linear structures not clearly combined with pigment network lines	Confluent junctional nests of melanocytes
5. Irregular pigmentation	Black, brown, and/or gray pigmented areas with irregular shape and/or distribution	Hyperpigmentation throughout the epidermis and/or upper dermis
6. Irregular dots/globules	Black, brown, and/or gray round to oval, variously sized structures irregularly distributed within the lesion	Pigment aggregates within stratum corneum, epidermis, dermo-epidermal junction, or papillary dermis
7. Regression structures	White areas (white scarlike areas) and blue areas (gray-blue areas, peppering, multiple blue-gray dots) may be associated, thus featuring so-called blue-whitish areas virtually indistinguishable from blue-whitish veil	Thickened papillary dermis with fibrosis and/or variable amounts of melanophages

Table 7 - The 7-point checklist.

A minimum total score of 3 is required for the diagnosis of melanoma

ELM criterion	Odds ratio ^a	7-point score ^b
Major criteria:		
1. Atypical pigment network	5.19	2
2. Blue-whitish veil	11.1	2
3. Atypical vascular pattern	7.42	2
Minor criteria:		
4. Irregular streaks	3.01	1
5. Irregular pigmentation	4.90	1
6. Irregular dots/globules	2.93	1
7. Regression structures	3.89	1

^aOdds ratios measuring the capacity of each criterion to increase the probability of melanoma diagnosis. ^bThe score for a criterion is determined on the basis of the odds ratio: >5 (score 2), and <5 (score 1). Simply add the scores of each criterion that is present within a pigmented lesion.

Table 8 - Menzies' method for the diagnosis of melanoma. For melanoma to be diagnosed a lesion must have neither of the two negative features and 1 or more of the 9 positive features

	Criterion	Definition
Negative features (Neither can be present)	Symmetry of pattern	Symmetry of pattern is required across all axes through the lesion's center of gravity (center of the lesion). Symmetry of pattern does not require shape symmetry
	Presence of a single color	The colors scored are black, gray, blue, dark brown, tan and red. White is not scored as a color.
Positive features (At least one feature must be present)	1. Blue-white veil	An area of irregular, <u>structureless</u> confluent blue pigmentation with an overlying white "ground-glass" haze. It can never occupy the entire lesion and cannot be associated with red-blue lacunes
	2. Multiple brown dots	Focal areas of multiple brown (usually dark brown) dots (not globules)
	3. Pseudopods	Peripheral bulbous and often kinked projections connected directly to the tumor body or to pigment network. They can never be seen distributed regularly or symmetrically around the lesion
	4. Radial streaming	Finger-like peripheral extensions never distributed regularly or symmetrically around the lesion
	5. Scar-like depigmentation	White distinct irregular extensions which should not be confused with hypopigmentation due to simple loss of melanin
	6. Peripheral black dots/globules	Black dots/globules found at or near the edge of the lesion
	7. Multiple (5-6) colors	The colors scored are black, gray, blue, dark brown, tan and red. White is not scored as a color.
	8. Multiple blue/gray dots	Foci of multiple blue or gray dots (not globules) often described as "pepper-like" in pattern
	9. Broadened network	A network made up of irregular thicker "cords" of the net, often seen focally thicker

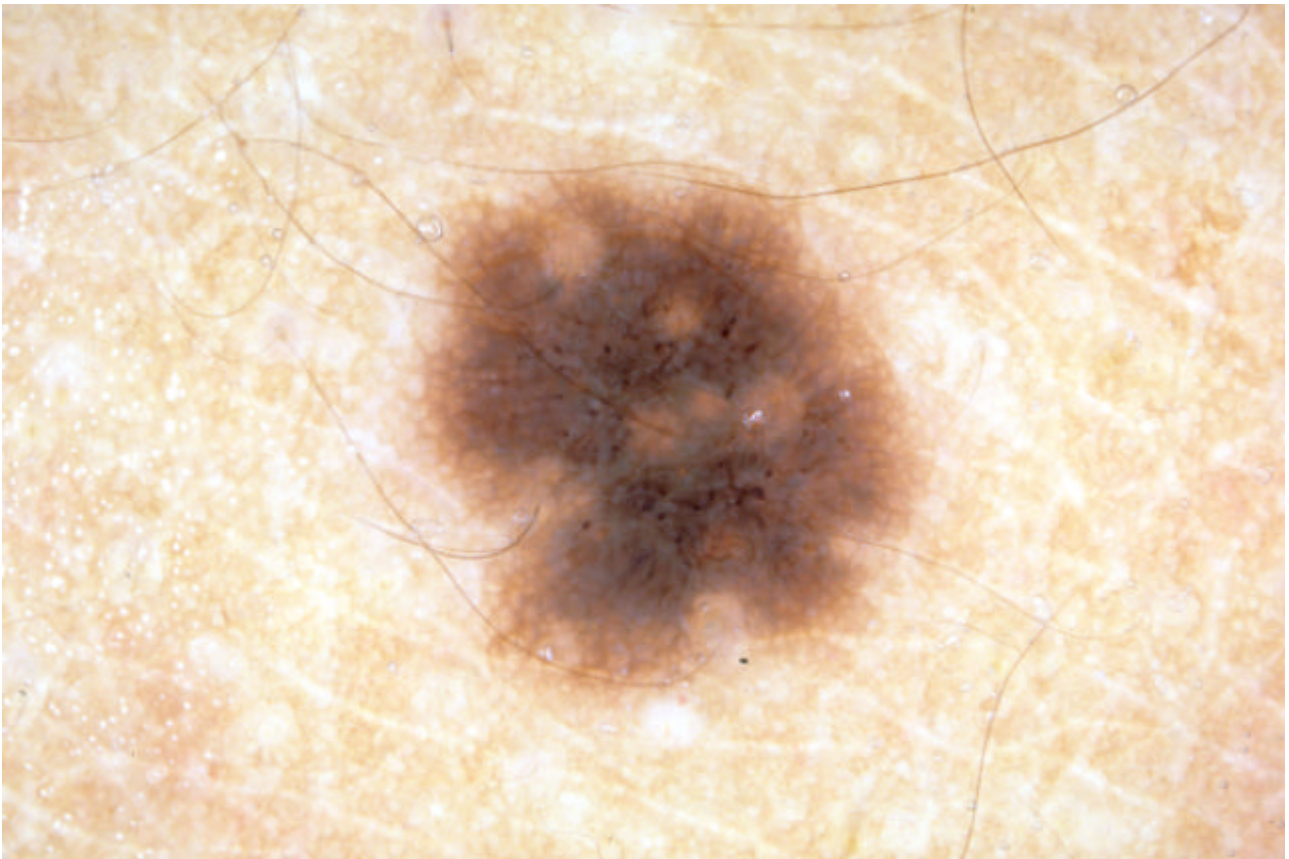


Fig. 1 – Clark nevus characterized by typical pigment network, regular dots/globules, and multifocal hypopigmentation (original magnification x10).

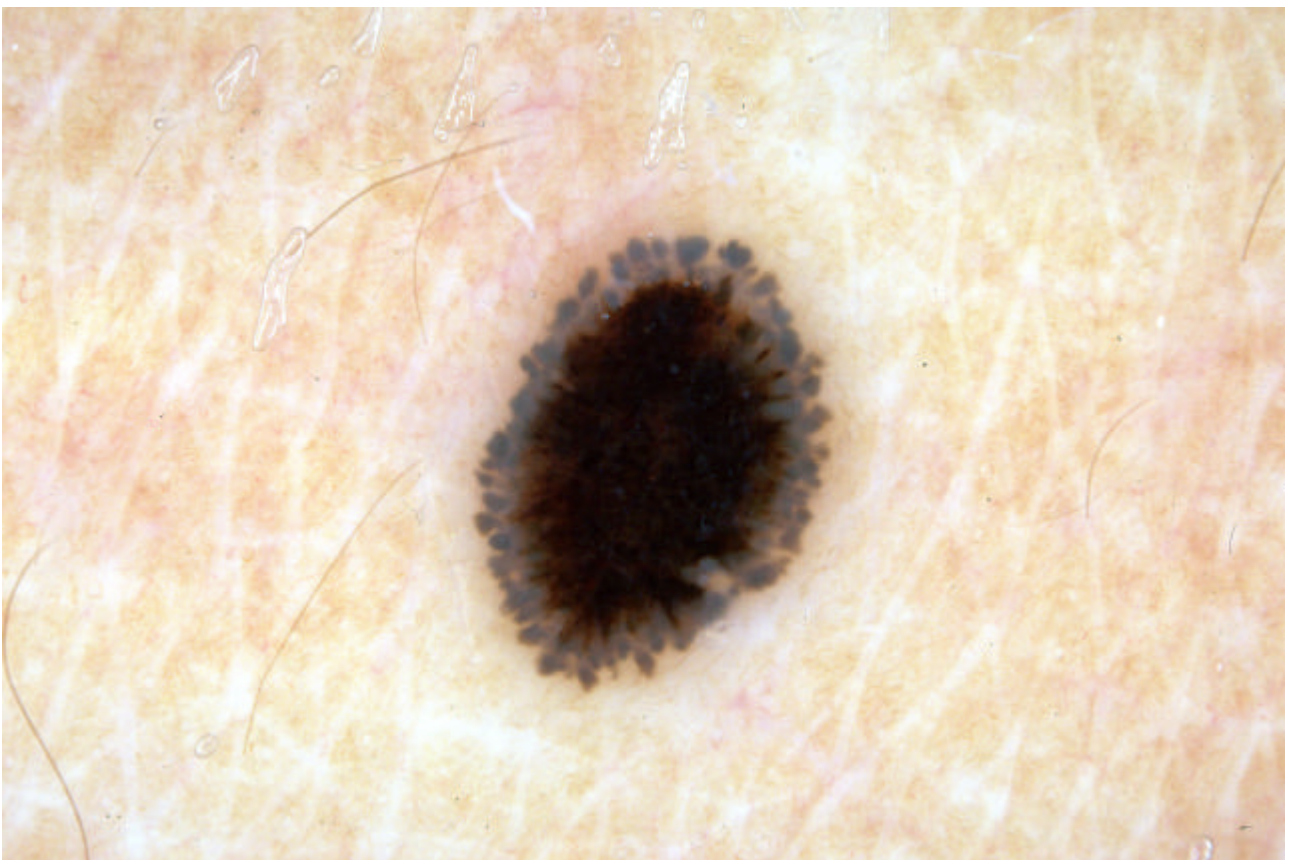


Fig. 2 – Reed nevus with starburst pattern typified by streaks regularly distributed along the periphery of the lesion (original magnification x10).

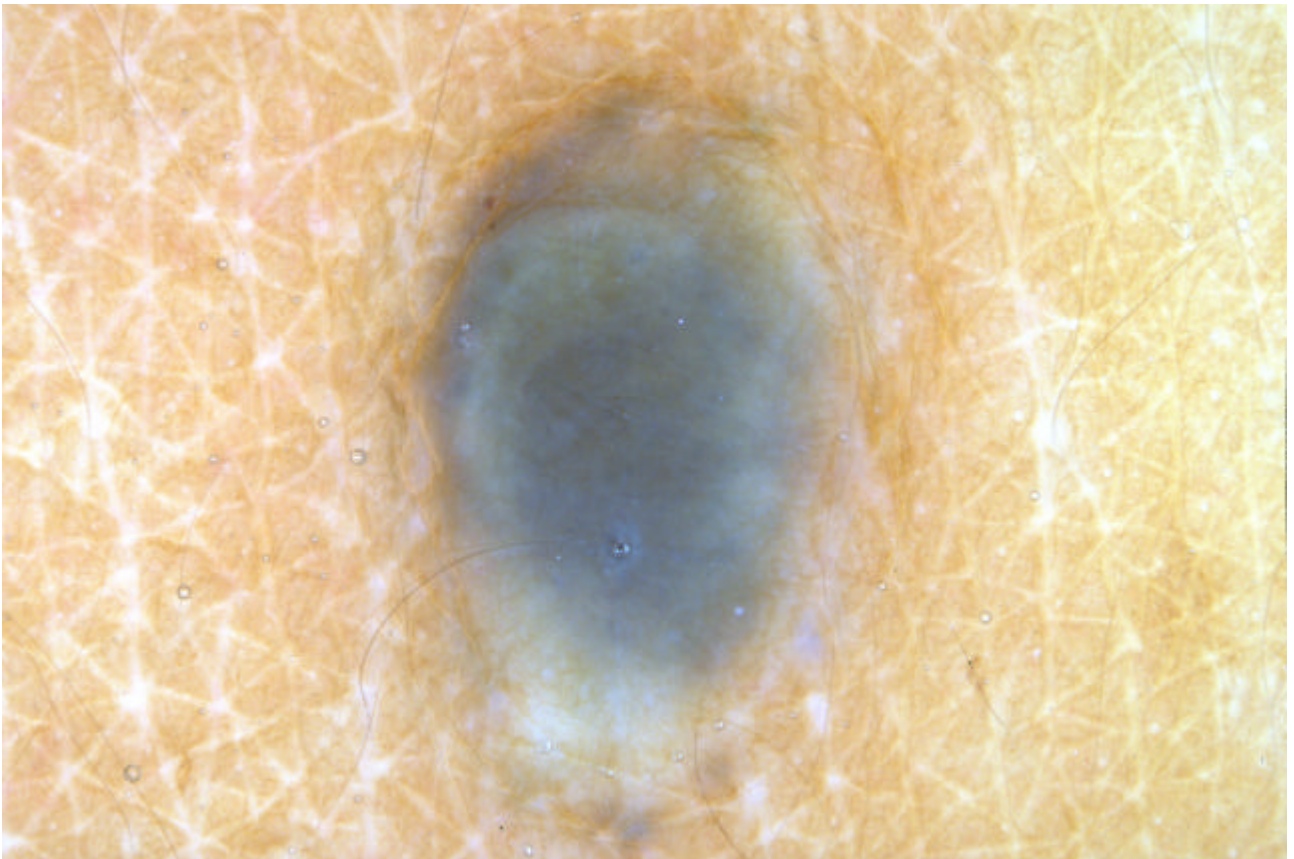


Fig. 3 – Blue nevus with homogeneous blue pigmentation (original magnification x10).

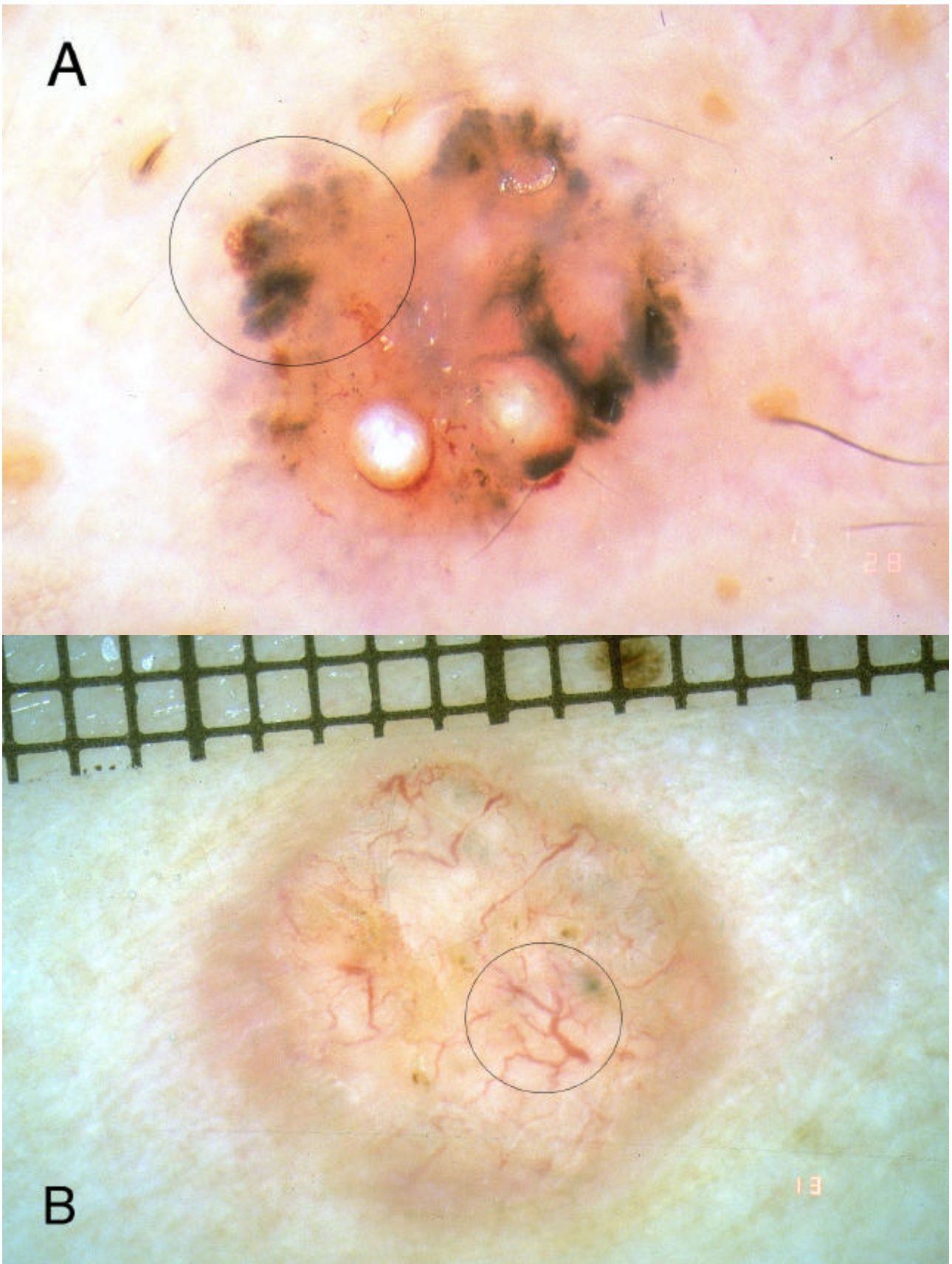


Fig. 4 – Two examples of basal cell carcinoma showing (A) leaf-like areas (circle) and (B) arborizing vessels (circle) (original magnification x10).



Fig. 5 – Seborrheic keratosis with multiple milia-like cysts (black circle) and comedo-like openings (white circle) (original magnification x16).

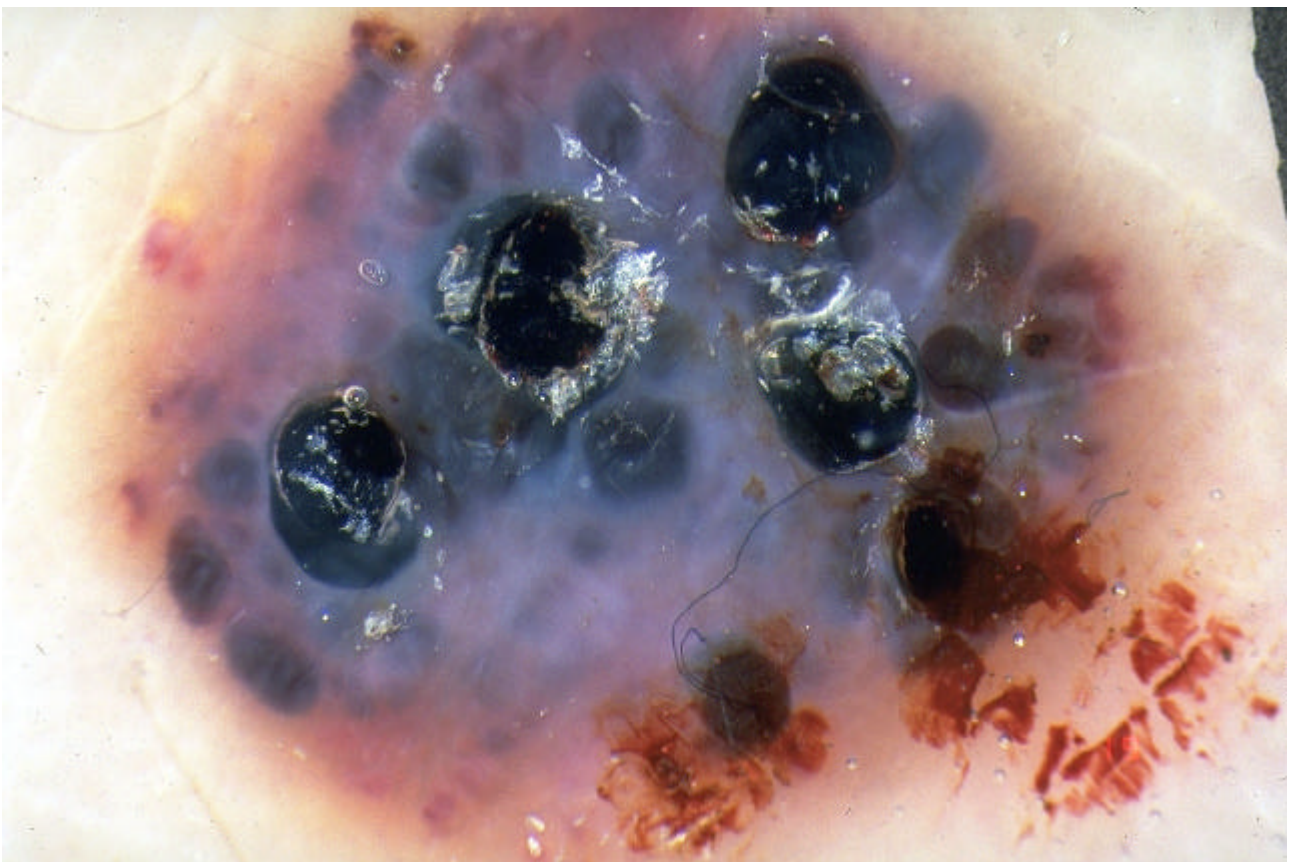


Fig. 6 – Angiokeratoma with lacunar pattern composed by red-bluish to red black, round to oval lacunas (original magnification x16).

Questions

1. Which is the most common dermoscopic pattern of melanoma in situ and early invasive melanoma on palms and soles?

- a. Parallel-furrow pattern
- b. Lattice-like pattern
- c. Parallel-ridge pattern
- d. Fibrillar pattern

Answer: c

2. Which is the most common dermoscopic pattern of Clark nevi?

- a. Reticular pattern
- b. Globular pattern
- c. Homogeneous pattern
- d. Multicomponent pattern

Answer: a

3. All the following dermoscopic features are suggestive of basal cell carcinoma except:

- a. Leaf-like areas
- b. Pigment network
- c. Arborizing vessels
- d. Blue-gray ovoid structures

Answer: b

4. Spitz/Reed nevi can be dermoscopically characterized by:

- a. Starburst pattern with regular streaks at the periphery
- b. Globular pattern with large brown globules at the periphery
- c. Atypical dermoscopic appearance with local features mimicking melanoma
- d. All the above

Answer: d

5. Which is the most common location of reticulated lentigo (ink-spot lentigo)?

- a. Upper limb
- b. Lower limb
- c. Back
- d. Chest

Answer: c

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REFERENCES

1. Pehamberger H, Steiner A, Wolff K. In vivo epiluminescence microscopy of pigmented skin lesions. I. Pattern analysis of pigmented skin lesions. *J Am Acad Dermatol* 1987;17:571-83.
2. Stolz W, Riemann A, Cognetta AB, et al. ABCD rule of dermatoscopy: a new practical method for early recognition of malignant melanoma. *Eur J Dermatol* 1994;4:521-527.
3. Argenziano G, Fabbrocini G, Carli P, De Giorgi V, Sammarco E, Delfino M. Epiluminescence microscopy for the diagnosis of doubtful melanocytic skin lesions. Comparison of the ABCD rule of dermatoscopy and a new 7- point checklist based on pattern analysis. *Arch Dermatol* 1998;134:1563-70.
4. Menzies SW, Ingvar C, Crotty KA, McCarthy WH. Frequency and morphologic characteristics of invasive melanomas lacking specific surface microscopic features. *Arch Dermatol* 1996;132:1178-82.
5. Wolf IH, Smolle J, Soyer HP, Kerl H. Sensitivity in the clinical diagnosis of malignant melanoma. *Melanoma Res* 1998;8:425-9.
6. Kittler H, Seltenheim M, Dawid M, Pehamberger H, Wolff K, Binder M. Morphologic changes of pigmented skin lesions: a useful extension of the ABCD rule for dermatoscopy. *J Am Acad Dermatol* 1999;40:558-62.
7. Kenet RO, Kang S, Kenet BJ, Fitzpatrick TB, Sober AJ, Barnhill RL. Clinical diagnosis of pigmented lesions using digital epiluminescence microscopy. Grading protocol and atlas. *Arch Dermatol* 1993;129:157-74.
8. Menzies SW, Ingvar C, McCarthy WH. A sensitivity and specificity analysis of the surface microscopy features of invasive melanoma. *Melanoma Res* 1996;6:55-62.
9. Pehamberger H, Binder M, Steiner A, Wolff K. In vivo epiluminescence microscopy: improvement of early diagnosis of melanoma. *J Invest Dermatol* 1993;100:356S-362S.
10. Schiffner R, Schiffner-Rohe J, Vogt T, et al. Improvement of early recognition of lentigo maligna using dermatoscopy. *J Am Acad Dermatol* 2000;42:25-32.
11. Oguchi S, Saida T, Koganehira Y, Ohkubo S, Ishihara Y, Kawachi S. Characteristic epiluminescent microscopic features of early malignant melanoma on glabrous skin. A videomicroscopic analysis. *Arch Dermatol* 1998;134:563-568.
12. Soyer HP, Smolle J, Leitinger G, Rieger E, Kerl H. Diagnostic reliability of dermoscopic criteria for detecting malignant melanoma. *Dermatology* 1995;190:25-30.
13. Argenziano G, Fabbrocini G, Carli P, De Giorgi V, Delfino M. Epiluminescence microscopy: criteria of cutaneous melanoma progression. *J Am Acad Dermatol* 1997;37:68-74.
14. Clark WH, Reimer RR, Greene M, Ainsworth AM, Mastrangelo MJ. Origin of familial malignant melanomas from heritable melanocytic lesions. "The B-K mole syndrome". *Arch Dermatol* 1978;114:732-8.
15. Ackerman AB, Cerroni L, Kerl H. Pitfalls in histopathologic diagnosis of malignant melanoma: Lea & Febiger, 1994.
16. Kreusch J, Koch F. [Incident light microscopic characterization of vascular patterns in skin tumors (published erratum appears in *Hautarzt* 1996 Jul;47(7):540)]. *Hautarzt* 1996;47:264-72.
17. Magana-Garcia M, Ackerman AB. Naming acquired melanocytic nevi. Unna's, Miescher's, Spitz's, Clark's. *Am J Dermatopathol* 1990;12:193-209.
18. Steiner A, Pehamberger H, Binder M, Wolff K. Pigmented Spitz nevi: improvement of the diagnostic accuracy by epiluminescence microscopy. *J Am Acad Dermatol* 1992;27:697-701.
19. Argenziano G, Scalvenzi M, Staibano S, et al. Dermoscopic pitfalls in differentiating pigmented Spitz naevi from cutaneous melanomas. *Br J Dermatol* 1999;141:788-93.

20. Kerl H, Smolle J, Hödl S, Soyer HP. Kongenitales Pseudomelanom. *Zeitschrift für Hautkrankheiten* 1989;64:564-568.
21. Bologna JL. Reticulated black solar lentigo ("ink spot" lentigo). *Arch Dermatol* 1992;128:934-940.
22. Rabinovitz H. *Dermoscopy. A practical guide.* Miami, Florida: MMA Worldwide Group Inc, 1999.
23. Barnhill RL, Albert LS, Shama SK, Goldenhersh MA, Rhodes AR, Sober AJ. Genital lentiginosis: a clinical and histopathologic study. *J Am Acad Dermatol* 1990;22:453-460.
24. Menzies SW, Westerhoff K, Rabinovitz H, Kopf AW, McCarthy WH, Katz B. Surface microscopy of pigmented basal cell carcinoma. *Arch Dermatol* 2000;136:1012-6.
25. Ferrari A, Soyer HP, Peris K, et al. Central white scarlike patch: A dermoscopic clue for the diagnosis of dermatofibroma [In Process Citation]. *J Am Acad Dermatol* 2000;43:1123-5.
26. Kreusch J, Rassner G. [Structural analysis of melanocytic pigment nevi using epiluminescence microscopy. Review and personal experiences]. *Hautarzt* 1990;41:27-33.
27. Nachbar F, Stolz W, Merkle T, et al. The ABCD rule of dermoscopy. High prospective value in the diagnosis of doubtful melanocytic skin lesions. *J Am Acad Dermatol* 1994;30:551-9.
28. Kreusch J, Rassner G. Standardisierte auflichtmikroskopische Unterscheidung melanozytischer und nichtmelanozytischer Pigmentmale. *Hautarzt* 1991;42:77-83.
29. Stolz W, Braun-Falco O, Bilek P, Landthaler M, Cognetta AB. *Color atlas of dermoscopy.* Berlin: Blackwell Science Ltd, 1994.
30. Bahmer FA, Fritsch P, Kreusch J, et al. Terminology in surface microscopy. *J Am Acad Dermatol* 1990;23:1159-1162.
31. Soyer HP, Smolle J, Hodl S, Pachemegg H, Kerl H. Surface microscopy. A new approach to the diagnosis of cutaneous pigmented tumors. *Am J Dermatopathol* 1989;11:1-10.
32. Yadav S, Vossaert KA, Kopf AW, Silverman M, Grin-Jorgensen C. Histopathologic correlates of structures seen on dermoscopy (epiluminescence microscopy). *Am J Dermatopathol* 1993;15:297-305.