Education

Dermoscopy: basic concepts

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Abstract

Dermoscopy is a very useful technique for the analysis of pigmented skin lesions. It represents a link between clinical and histological views, permitting an earlier diagnosis of skin melanoma. It also helps in the diagnosis of many other pigmented skin lesions, such as seborrheic keratosis, pigmented basal cell carcinoma, hemangioma, blue nevus, atypical nevus, and mole, which can often clinically simulate melanoma. In this article, dermoscopy is reviewed from its history to the basic concepts of the interpretation of dermoscopic images. The goal is to introduce this subject to those not yet familiar with it, in order to instigate and encourage the training and practice of this technique of growing importance for everyday usage.

History

The 1980s can be considered as the heyday of dermoscopy, with the definition of criteria for dermoscopy and the first Consensus Conference on Skin Surface Microscopy;[1] however, the origins of the dermoscopic technique go back as far as the 17th century, when Kohlhaus first examined ungual matrix vessels under the microscope.[2]

In the 19th century, Unna suggested the term "diascopy" after examining a case of *lupus vulgaris* with a glass lens over the patient's skin surface.[3] It was only in the mid-20th century, however, that the first dermoscopic binocular was produced by Zeiss, and the term "dermoscopy" was introduced by Saphier.[3] Surface microscopes were relatively large and unwieldy, and were thus not very popular amongst doctors. In the second half of the 20th century, Goldman[4] developed the first portable dermoscope, and analyzed nevi and melanoma with monocular devices. Rona Mackie,[5] in 1971, clearly established the benefits of dermoscopy in the preoperational diagnosis of doubtful pigmented cutaneous lesions.

In 1981, Fritsch and Pechlaner[6] distinguished benign from malignant skin lesions according to the characteristics of the pigmented net of the lesions. In 1987, Pehamberger *et al.*[7] introduced the analysis of patterns for the diagnosis of pigmented cutaneous lesions, and, in 1989, Soyer *et al.*[8] established a correlation between dermoscopic and histopathologic structures. In the same year, the 1st Consensus Conference on Skin Surface Microscopy was held in Hamburg, Germany,[1] where a terminology for dermoscopy was defined.

In 1990, Kreusch and Rassner[9] published the first *Dermoscopy Atlas*. Later, several researchers, such as Stolz *et al.*,[10] Menzies,[11] and Argenziano *et al.*,[12] proposed the performance of analyses of pigmented lesions, and, in 2000, a virtual Consensus Net Meeting on Dermoscopy was held.[2,12,13] From 2000 to the present, interest in this technology has been increasing, with the global spread of dermoscopy and the production of several courses, books, publications, and symposia on the theme,[14–17] as well as the founding of the International Society of Dermoscopy.[18]

Definition

Also known as surface microscopy or epiluminescent microscopy, dermoscopy is a technique that allows the visualization of pigmented cutaneous lesions *in vivo* right to the starting edge of the reticular dermis.[19,20] The technique involves the use of a device similar to an otoscope, but provided with a specific contact lens, the dermatoscope (Fig. 1), which generates a beam of light that falls on the cutaneous surface at an angle of 20°. Placing a fluid (oil, water, gel, alcohol-gel, or glycerin) at the interface between the epidermis and the device's glass slide, light reflection is eliminated, allowing the visualization of the dermoscopic characteristics resulting from the presence of melanin and hemoglobin in the different skin layers. New polarized light dermatoscopes do not require the use of fluid systems, but many workers still use polarized light dermatoscopes with fluid systems. The usual magnification provided by the dermatoscope is 10-fold, but digital dermatoscopes already exist with magnifications of up to 70-fold, with maintenance of image definition.[21]

The dermatoscope, despite its ease of handling, is not a mere magnifying glass, but a more complex instrument, allowing the superimposition of the skin layers. This is

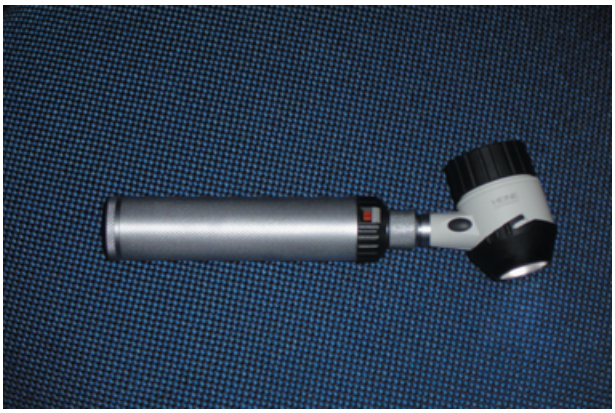

Figure 1 Manual dermatoscope

entirely different from the image obtained in histopathology, where the visualization is total, with the possibility to observe any surface or deep skin layer. It is usual to compare the visualization provided by the dermatoscope to an aerial view of the skin, as from a helicopter, whereas, in histopathology, a deeper view is obtained, comparable with that produced from a submarine. The images seen through a dermatoscope are therefore different from a clinical image, and also different from the images studied in cutaneous histopathology. Dermoscopy therefore represents a very useful interface between these two areas.

Dermoscopic criteria

Color

Depending on the location of melanin in the different skin layers, the colors shown in Table 1 (Figs 2–11) can be observed by dermoscopy.

Therefore, color is a dermoscopic criterion that aids in the interpretation of a doubtful pigmented lesion: a lesion that is only light and dark brown indicates an epidermal location of melanin, such as a melanocytic junctional nevus (Fig. 6), whereas a lesion that is only blue indicates melanin only in the dermis, as in a blue nevus (Fig. 10). Compound melanocytic nevi have a brown or gray-bluish color (Fig. 8). A cutaneous melanoma often shows a multicolored pattern (Figs 2, 4, and 7).

Dermoscopic structures

Therefore, it is melanin, whether inside melanocytes, nevic cells, keratinocytes, or melanophages, that will determine the color in dermoscopy. Moreover, melanin will also determine certain "structures" by its appearance as clusters in these cells, in isolation, or concentration at the lesion periphery. Similarly, hemoglobin, depending on its distribution in the lesion, will also determine structures and patterns of vascularization. Table 2 shows the structures observed in dermoscopy.

Evaluation of pigmented lesions

To begin the evaluation of a pigmented lesion with a dermatoscope, it is necessary to be familiar with the aforementioned nomenclature.

In summary, the visual patterns shown in Table 3 can be used as reference.[13,14]

If the lesion is classified as "melanocytic," the next step is to evaluate whether it is benign, somewhat suspect, or highly suspect of being a melanoma. To this end, certain analysis techniques can be used for these types of lesion. All are quite interesting, and the dermoscopy practitioner should choose the model he or she prefers to evaluate the lesion being examined. There are semiquantitative models (ABCD rules, rule of seven points, and rule of three points) and qualitative diagnostic models (Menzies' method, pattern analysis).

ABCD rule[10]

The melanocytic lesion is divided with two perpendicular axes and its **a**symmetry is assessed (not only with regard to form, but also to the disposition of the structures in the lesion). If asymmetric in both axes, it will score 2.6; if asymmetric in only one of the axes, it will score 1.3; if totally symmetric, it will score zero.

Table 1 Dermoscopy – color and location of melanin

	Color	Representation
1	Black (Figs 2–5)	Indicates presence of melanin in the spinous layer
2	Light or dark brown (Figs 2–6)	Demonstrates presence of melanin in the dermal–epidermal junction and horny layer
3	Gray-bluish (Figs 4, 7–9)	Reveals melanin in the papillary dermis
4	Blue (Fig. 10)	Indicates melanin in the reticular dermis
5	White (Fig. 4)	Appears in the presence of fibrosis or lesion regression, but the white color must be lighter than the color of the lesion periphery
6	Red (Fig. 11)	Represents the presence of hemoglobin inside the vessels

Based on the Hamburg Consensus.[1]

Table 2 Structures observed by dermoscopy

	Structures observed at dermoscopic examination	Representation
1	Pigmented net (Figs 2, 4, 6)	Reveals melanin at the dermal–epidermal junction of melanocytic lesions. It is a honeycomb-type tissue, whose lines correspond to melanin and "holes" to papillary dermis, without melanin, in a cross-section of the epidermis with elongated crests. This criterion defines a pigmented lesion as melanocytic. There are two exceptions when the presence of a net does not indicate a melanocytic lesion: dermatofibroma and extra nipple
2	Clustered globules (Figs 4, 8)	This is another criterion for a melanocytic lesion, and represents the presence of clustered melanin, e.g. on the inside of nevic cell nests. These rounded structures may present different colors, depending on the degree of aggregation of melanin
3	Ramified streaks (Fig. 2)	This is a third criterion for a melanocytic lesion, representing the radial growth of cells containing melanin. This is a "fringe"-type structure at the periphery of the lesion. Its presence in the lesion, especially if asymmetric, is suggestive of cutaneous melanoma. If present in the entire lesion periphery, in a symmetric disposition, it may represent the pattern found in Spitz's pigmented nevus (Reed's nevus)
4	Dots (Figs 2, 7)	Rounded structures of less than 0.1 mm in diameter (smaller than globules). If black or brown, they represent the accumulation of pigment in the horny or granular layer. In benign lesions, they are located in the center of the lesion (Fig. 6). When found in the periphery, they represent an active lesion, and may indicate an atypical structure or even a melanoma. A multiple gray-bluish occurrence indicates melanophages in the dermis, and a spotted pattern or pattern resembling "black pepper grains" suggests melanoma
5	Areas without structures (Fig. 4)	Amorphous or homogeneous areas, areas without nets, and shadowed areas of different tones represent small or poorly pigmented epidermal crests. They are not specific of a melanocytic lesion
6	Blue-metallic areas (Fig. 10)	Homogeneous blue pigmentation with the absence of pigmented nets or brown or black globules is quite characteristic of blue nevus. Brown areas may be present when there is junctional activity or in combined nevi (melanocytic nevus in association with blue nevus)
7	Horny pseudocysts (Fig. 3)	Pale-yellow circular areas are typical of seborrheic keratoses, mainly multiple keratoses. These are intra-epidermal keratin accumulations
8	Follicular pseudo-openings (Fig. 3)	Openings of the comedone type; orifices of dark or light coloration. They characterize seborrheic keratoses, but can also occur in papillomatous nevi
9	Red-bluish "lakes" (Fig. 11)	These well-defined ovoid structures represent increased and dilated vascular spaces in the papillary dermis. They are pathognomonic of hemangioma
10	Maple leaf-type structures (Fig. 9)	These discrete bulbar extensions of brownish to gray-bluish color, in the direction of the normal skin, as fingers, are the nests of pigmented epithelial nodules of basal cell carcinoma (BCC)
11	Pseudopods	These extremities of radial streaks, observed as nodular or bulbar projections, are suggestive of invasive melanoma. They are usually heavily pigmented
12	Blue-whitish veil (Fig. 4)	Confluent, opaque, irregular blue pigmentation, with a whitish film resembling a "bottle bottom", reveals the presence of orthokeratosis and compact aggregation of pigmented cells in the dermis. Usually found in lesions of invasive melanoma
13	Depigmentation areas	White areas, lighter than the adjacent normal skin, can indicate histopathologic regression of pigmented lesions and eventually fibrosis in an invasive melanoma
14	Fissures and crypts	Patterns of circumvolutions and grooves, similar to the surface of the human cortex, are typically observed in seborrheic keratoses
15	Fingerprint-like pattern	Found in flat seborrheic keratoses and solar lentigo (freckle). These are fine compact strings of brown–white coloration
16	Vascularization: several patterns of vascularization are seen with dermoscopy	• Erythema: presence of diffuse areas of pink-reddish color. Nonspecific and frequent in melanoma, but also in any irritated lesion • Telangiectasia: ramified dilated vessels. Frequent on the face and, if branch-like, suggestive of BCC (Fig. 9) • Red lines and red spots: polymorphous and irregular pattern with small parallel and vertical vessels. Found in invasive melanoma • Red-milky globules: occur in melanoma as very vascularized melanocytic masses • Vessels in uniform hairpin form: seen in seborrheic keratoses • Vessels in irregular hairpin form: with bizarre patterns of vases on the surface and suggestive of melanoma
17	Large ovoid blue-grayish nests	Irregular rounded areas, larger than globules, confluent or not, but not closely connected to the body of the pigmented tumor. They correspond to intradermal epithelial masses and are indicative of pigmented BCC
18	Radial areas	These radial projections converging to a darker center are similar to the spokes of a bicycle wheel, and are found in the periphery of BCCs
19	Ulceration	Occurs precociously in the evolution of BCC and later in invasive melanoma. In the absence of a net, suggestive of BCC

Table 2 *Continued*

	Structures observed at dermoscopic examination	Representation
20	Structures found on the face	• Pseudo-net (Fig. 7): rough reticular pattern found on the face as a result of the absence of epidermal cones. Around the cutaneous appendages in the face (clear spaces): hair follicle openings and ostia of sweat glands. They are present in melanocytic lesions and flat seborrheic keratoses on the face • Asymmetric follicular openings (Fig. 7): darkened pigmentation with asymmetric distribution around follicular openings. These are melanoma cells that migrate to the follicular wall. They occur in the initial malignant lentigo • Rhomboid structures (Fig. 7): evolution of the malignant lentigo, noticeable as dark pigmentation around the follicles, producing an "enlarged pseudo-net" on the face. They are highly suggestive of melanoma of the malignant lentigo type, and can be very wide, obliterating the follicular ostia and forming dark homogeneous areas
21	Structures found in the palmoplantar region	In this location, the pigmented net has a morphologic aspect different from that in other anatomic sites: • In benign nevus: a. Pattern of parallel furrows: furrows of the cutaneous surface are pigmented b. Lattice-like pattern (Fig. 5): besides pigmentation, lines cross the grooves c. Fibrillary pattern: delicate fibers crossing the natural furrows of the skin • In melanoma: a. Pattern of parallel ridges: inverse pattern to that of parallel furrows, where the crests are pigmented b. Bizarre pattern: a combination of alterations. Red-milky areas can be present

Updated at the consensus meeting via the Internet.[12]

Table 3 Dermoscopic algorhythm – melanocytic versus non-melanocytic lesions

Visual pattern	Pigmented lesion
1 Pigmented net or aggregated globules or ramified streaks	Melanocytic lesion
2 Homogeneous blue area	Blue nevus
3 Horny pseudocysts, follicular pseudo-openings or fissures and crypts, or fingerprint	Seborrheic keratosis
4 Aggregated red "lakes"	Hemangioma
5 Areas resembling a maple leaf, radial areas, telangiectasia, and ulceration	Basal cell carcinoma
6 None of the above patterns (by exclusion)	Melanocytic – can represent a totally atypical lesion of cutaneous melanoma, and should therefore be excised

From Stolz, Braun-Falco & Bilek *et al.*[14]

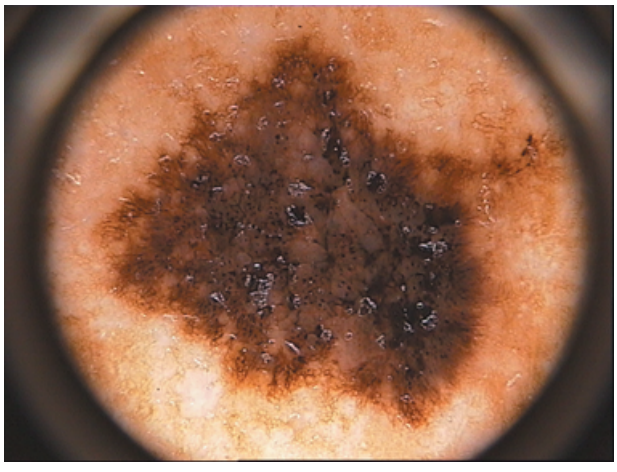

Figure 2 Presence of irregular streaks (1), abrupt margins, and asymmetry – cutaneous melanoma

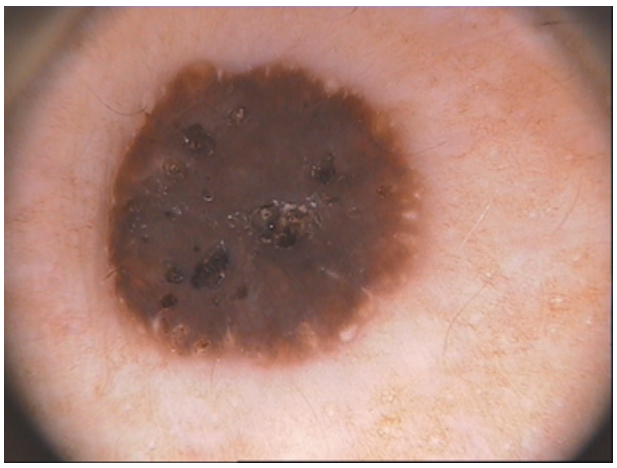

Figure 3 Absence of criteria of a melanocytic lesion; presence of follicular pseudo-opening (1) and corneal pseudocysts – seborrheic keratosis

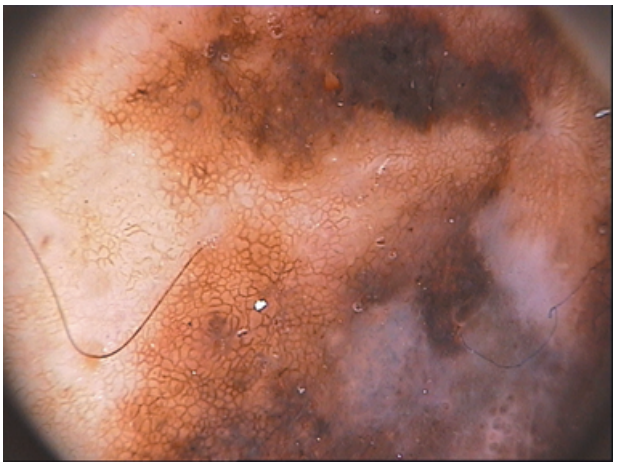

Figure 4 Multicomponent pattern: enlarged pigmented net (1), bluish-gray veil (2), and asymmetry – cutaneous melanoma

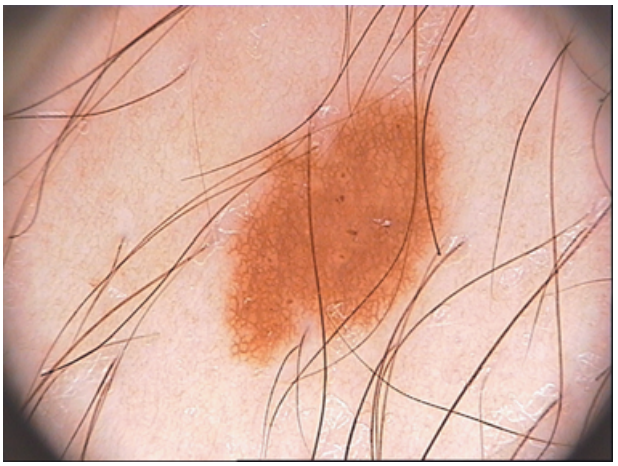

Figure 6 Regular pigmented net (1) and some central brown dots (2) – junctional melanocytic nevocellular nevus

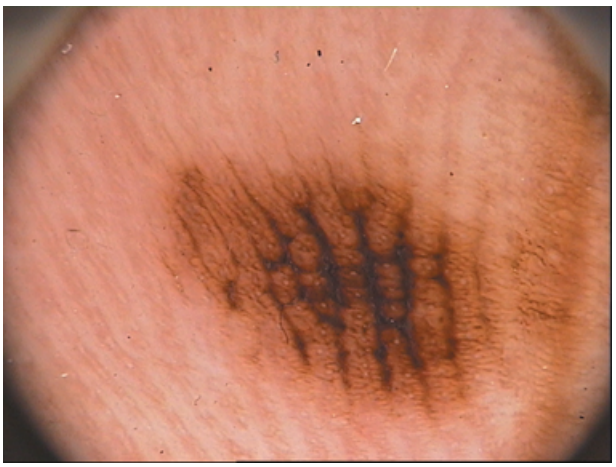

Figure 5 Lattice-like pattern – acral nevus

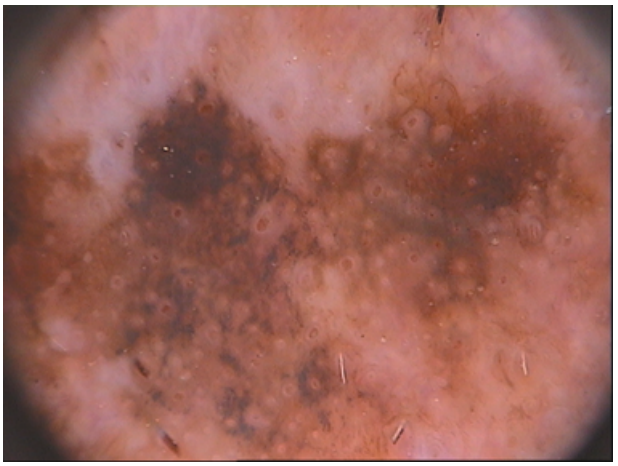

Figure 7 Granular annular structures (1), rhomboidal structures (2), and obliteration of facial follicular openings – lentigo maligna melanoma

The borders are also observed, dividing the lesion with four axes, giving a total of eight borders. The abrupt end of the pigmentation or the net is evaluated, with a score of zero if the pigmentation gradually fades towards the periphery. Each abrupt border scores 0.1.

There are six possible colors in dermoscopy (black, dark brown, light brown, gray-bluish, white, and red), and each color found scores 0.5.

Finally, there are five different possible structures in ABCD dermoscopy (pigmented net, clustered globules, ramified streaks, amorphous area, and dots), and the score is 0.5 for each structure.

The higher the score, the greater the probability for the melanocytic lesion to be highly suspicious of melanoma (> 5.45); if above 4.75, the lesion is considered as suspect, as a dysplastic nevus, and, in this case, an excision should be assessed; if the total score is less than 4.75, the melanocytic lesion is considered to be benign.

Rule of seven points[12]

In this method, seven dermoscopic characteristics are assessed, divided into major (two points) and minor (one point) criteria. If the total score is below three, the lesion is considered to be benign, but, if equal to or higher than three, the lesion is diagnosed as melanoma. The major criteria are an atypical pigmentary net, blue-whitish veil, and atypical vascular pattern. The minor criteria include radial streaks and pseudopods, irregular pigmentation, globules and irregular spots, and regression patterns.

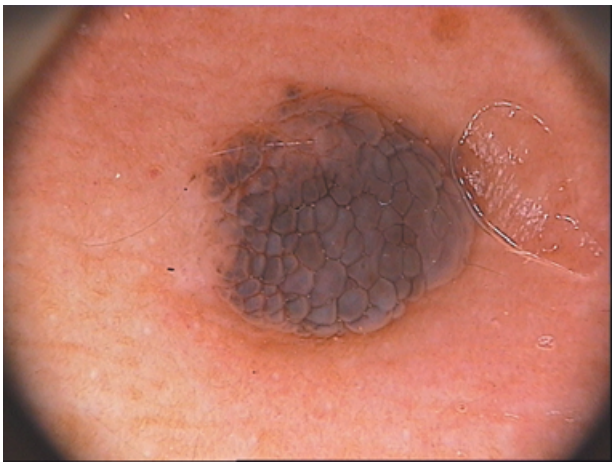

Figure 8 Presence of grouped bluish-gray globules (1) – compound melanocytic nevocellular nevus

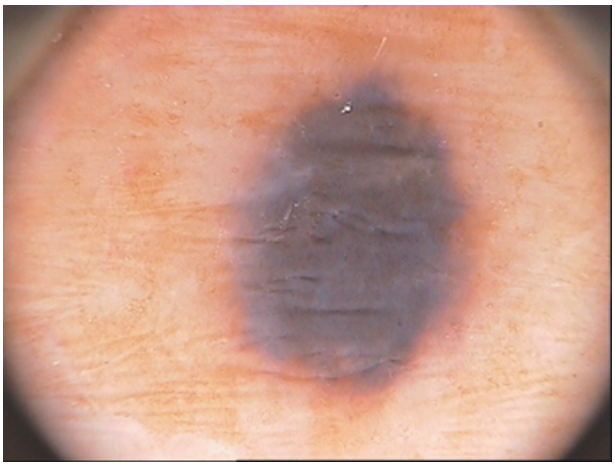

Figure 10 Absence of criteria of a melanocytic lesion; presence of a bluish-gray homogeneous area – blue nevus

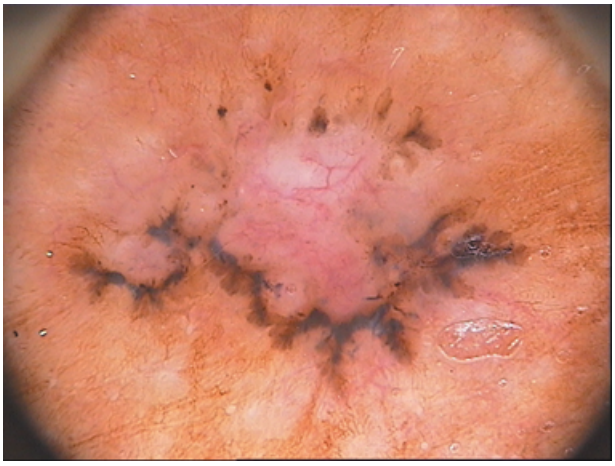

Figure 9 Absence of criteria of a melanocytic lesion; presence of telangiectasia (1) and leaf-type structures (2) – pigmented basal cell carcinoma

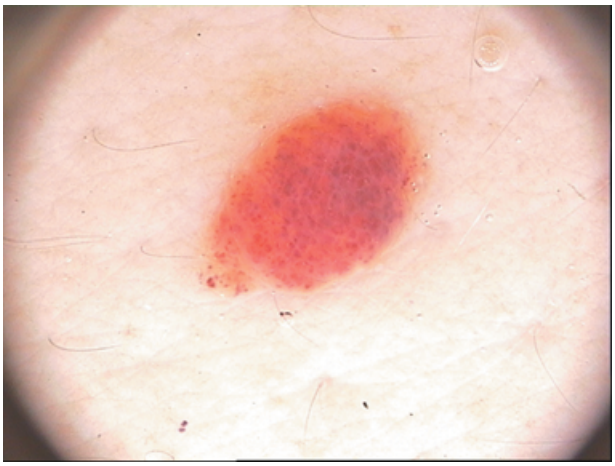

Figure 11 Absence of criteria of a melanocytic lesion; presence of red-bluish "lakes" – hemangioma

Rule of three points[12]

This method was developed specifically for novice dermoscopists with little training to help them to avoid the misdiagnosis of melanoma whilst improving their skills. The presence of two or three criteria is suggestive of a suspicious lesion, and this lesion must be excised. These criteria are as follows: (i) asymmetry (of color and structure in one or two perpendicular axes); (ii) atypical network (pigmented network with irregular holes and thick lines); and (iii) blue–white structures (any type of blue and/or white color). This three-point checklist was designed to be used as a screening method.[22]

Menzies' method[11]

According to this classification, 11 dermoscopic characteristics are considered, divided into negative and positive. The negative characteristics define the lesion as benign, and are the symmetry of the lesion and a single color. The positive characteristics are a blue-whitish veil, multiple brown dots, pseudopods, radiated streaks, areas of scar depigmentation, dots and black globules in the periphery of the lesion, multiple colors (five or six), multiple dots and blue globules, and enlarged pigmentary net. The presence of a positive characteristic, added to the absence of negative characteristics, is sufficient for the diagnosis of cutaneous melanoma.

Analysis of patterns[7]

The pigmented lesions are analyzed initially with regard to their general pattern, and afterwards by their local pattern, taking the following criteria into account: regular and irregular pigmentary net, pseudopods, radial streaks, dots and globules, blue-whitish veil, regression areas, hypopigmentation, amorphous areas (blots), vascular pattern, dermoscopy of the face, palmoplantar area, and nonmelanocytic lesions.

The global patterns are as follows: reticular pattern (predominant pigmented net: benign melanocytic lesion); globular pattern (prevalence of globules: compound and intradermal nevi); rectangular street pavement pattern – parallelepipeds (boxed-in globules: highly specific of compound and intradermal nevi); pointillist pattern (regular brown or gray-bluish dots at the base of the skin color: compound and intradermal nevi); homogeneous pattern (homogeneous pigmentation in the lesion: if blue, highly suggestive of blue nevus); parallel pattern (junctional palmoplantar nevi); pattern in star "burst" (radial streaks or pseudopods regularly distributed in the periphery of the lesion: Reed's nevus); multicomponent pattern (three or more areas of the lesion with different dermoscopic characteristics: highly specific of cutaneous melanoma); unspecific pattern (commonly found in cutaneous melanoma); and nonestablished pattern (possible melanoma).

The local patterns are as follows: pigmented net (if typical, benign melanocytic lesion; if atypical, probable melanoma); dots and globules (if regular, benign melanocytic lesion; if irregular, probable melanoma); streaks (if regular, benign melanocytic lesion – Reed's nevus; if irregular, probable melanoma); bluish veil (melanoma); regression areas (white or with blue dots, as "black pepper grains" – melanoma); hypopigmentation is a nonspecific criterion; area without structure (symmetric, benign melanocytic lesion; asymmetric, probable melanoma).

There are also vascular characteristics: vessels in the form of a comma (intradermal nevus); vessels in a hairpin shape (if regular, seborrheic keratosis; if irregular, consider as melanoma); vessels in the form of dots (melanoma); irregular linear vessels (melanoma); vessels and/or erythema, with regression structures (melanoma).[7]

Finally, characteristics related to location should be considered. Face: typical pseudonet (benign melanocytic lesion); granular ring structures (melanoma); gray pseudonet (melanoma); rhomboid structures (melanoma); asymmetric pigmentation of the follicles (melanoma). Palms and soles: parallel furrow pattern (acral nevus); lattice pattern (acral nevus); fibrillary pattern (acral nevus); parallel ridge pattern (melanoma).[7]

Discussion

Dermoscopy is a technique with an increasing number of subscribers in all areas of medicine, but mainly in dermatology. It involves a complementary examination of pigmented lesions on the skin, increasing the chance of an accurate diagnosis of cutaneous melanoma. It is a relatively simple technique that can be carried out in a doctor's office, clinic, or hospital, with the use of a portable device (manual dermatoscope). Any lesion suspected of being a melanoma should be evaluated, and later confirmed by histopathology.[10]

The interpretation of dermoscopic images requires training, as it involves not only an increase in lesion size, but also an evaluation of the image with regard to the presence of melanin and hemoglobin in the different layers of the epidermis and dermis. Benign lesions, such as seborrheic keratosis, junctional nevi, compound and intradermal nevi, congenital nevi, blue nevi, solar lentigo, hemangioma, angiokeratoma, and dermatofibroma, have peculiar characteristics in dermoscopy that corroborate their diagnosis and, in these cases, unnecessary biopsies can be avoided.

One of the most relevant indications for the use of dermoscopy is a patient with multiple nevi (atypical nevi) and/or a history of melanoma. Dermoscopy can demonstrate the most suspect lesions to be excised. Moreover, modifications in the appearance of suspect lesions can be followed up using body mapping by taking clinical and dermoscopic photographs of the pigmented lesions.[11]

Basal cell carcinoma, especially its pigmented variant, also shows special characteristics in dermoscopy. It can be diagnosed easily using this examination, and then directed for excision and histopathologic confirmation.

Cutaneous melanoma can exhibit a multiplicity of characteristics (dermoscopic variation of colors and structures, and asymmetry). Dermoscopy facilitates diagnostic suspicion, and is capable of predicting the depth of the tumor, as melanoma *in situ* and melanoma with dermal invasion exhibit visible differences on close examination. Obviously, it cannot replace a confirmation by the Breslow index and Clark level by histopathology.[12]

Conclusion

Dermoscopy enables a trained doctor to obtain a good interpretation of a pigmented lesion and a definition of whether or not it is likely to be melanocytic. This examination should be used more frequently, as it allows the possibility of a preoperative diagnosis, improving the prospects for melanoma patients.

This article is an overview of dermoscopy, from its history to the basic notions of interpretation of dermatoscopic images. The goal is to introduce this subject to those not yet familiarized with it, instigating and encouraging the training and practice of this technique of growing importance for everyday usage. In order to acquire a basic knowledge of dermoscopy, the reader is encouraged to study one of the major textbooks on this subject published in recent years.

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