Principles of Dermatoscopy of Pigmented Skin Lesions

Wilhelm Stolz, U. Semmelmayer, K. Johow, and Walter H. C. Burgdorf

There has been a dramatic increase in the incidence of malignant melanoma in most parts of the world. Because the tumor thickness is the most important prognostic factor for the prognosis of the malignant melanoma, the early detection of thin melanomas is essential. Dermatoscopy allows the physician to discriminate between melanocytic and nonmelanocytic lesions with high diagnostic accuracy and to detect initial malignant melanomas. We review the principles of dermatoscopy and the differential diagnosis of pigmented skin lesions. Before using the ABCD rule of dermatoscopy to classify melanocytic lesions into benign, suspicious, or malignant, the distinction between melanocytic and nonmelanocytic lesions is necessary. An essential prerequisite for the usefulness of this technique is adequate training.

Because the prognosis of melanoma depends almost entirely on tumor thickness, early detection of correspondingly thin melanomas is extremely important for the survival of patients. With increased public concern about changing melanocytic nevi, dermatologists are consulted more often and earlier with regard to subtle, flat, small diameter, and equivocal lesions. While a wide variety of diagnoses must be considered when analyzing pigmented skin lesions, the problem is usually distinguishing between a benign melanocytic nevus and a malignant melanoma.

For the preoperative naked eye, diagnosis of malignant melanoma, the clinical ABCD rule is widely used; it states that a malignant melanoma is likely to be present if a pigmented skin lesion displays the following criteria: asymmetry, irregular border, variable color, and a diameter of more than 6 mm. Our clinical impression is that this rule is more sensitive than specific. If it were strictly adhered to, many benign lesions would often be excised as suspicious lesions, so that an excess number of surgical procedures and histological tests would be performed. A marked improvement in the preoperative diagnosis of pigmented skin lesions is possible with dermatoscopy (dermoscopy, epiluminescence microscopy). In a recent meta-analysis of 22 studies with 9,004 pigmented skin lesions, experts with dermatoscopy achieved a 35% increase in diagnostic accuracy as compared to clinical assessment, yielding a diagnostic sensitivity of 89% and a specificity of 79%. A French meta-analysis also showed that dermatoscopy had significantly higher discriminating power than clinical examination, with estimated odds ratios of 76 and 16, respectively.

The essence of today's algorithmic approach to pigmented skin lesions includes first deciding if a lesion is melanocytic or not and then determining the malignant potential of melanocytic lesions. Nachbar et al proved in a prospective study that with the application of this algorithm, the correct diagnosis of pigmented nonmelanocytic lesions can be increased by more than 30%. For discrimination of nonmelanocytic lesions at the Consensus Net Meeting on Dermoscopy 2000, which was held prior to the 2001 15th World Congress of Dermoscopy, all experts agreed on a multi-step procedure, which is also the basis for our approach. At the same meeting, the 4 systems most widely used to assess melanocytic lesions were compared. These are the modified pattern analysis (Soyer et al and Pehamberger et al), the ABCD rule of dermatoscopy (Stolz et al, Menzies's scoring method, and the 7-point checklist (Argenziano et al). All methods have been shown to improve melanoma diagnostic accuracy. The particular method chosen by clinicians will depend on their experience and confidence in using that method.

Herein, we present an approach to pigmented skin lesions that we believe allows the physician to...
achieve a diagnostic accuracy using a minimum number of criteria. More details and numerous cases illustrating our criteria are given in the second edition of the *Color Atlas of Dermatoscopy* from Stolz et al.\textsuperscript{32}

**INSTRUMENTS**

Over the past 20 years, the equipment available for dermatoscopy has evolved dramatically. The initial investigations by the groups in Graz and Vienna were performed with stereo microscopes. To overcome the difficulties of stereomicroscopes, we developed the dermatoscope, which is light and easy to handle.\textsuperscript{4} This apparatus resembles an otoscope with an achromatic lens incorporated into a focusing ring and a halogen lamp. A fluid is placed on the lesion and the glass plate on the bottom of the dermatoscope is lightly pressed against the skin. Today, a wide of hand-held instruments are available (Heine, Germany; Welch-Allyn). Recently, we improved our original dermatoscope, which now has light diodes and an aspheric 10x optics (Linos AG, Isartalstr. 43, D-80469 München). The unit has a rechargeable power handle with a desk-top charging base, as well as a special head with a contact cylinder only 8 mm in diameter for lesions in recessed areas (finger and toe webs, nasal and auricular folds).

**PHYSICAL CHARACTERISTICS**

By using dermatoscopy a deeper insight into the skin is possible. Light entering the skin is either reflected by the stratum corneum, dispersed, or absorbed in the tissue. The more irregular the skin surface, the higher the amount of light that is reflected and the lower the amount of light that penetrates the deeper epidermal and dermal structures. An undisturbed view of these structures can be achieved by the optical linkage of the stratum corneum, which has a reflection index of 1.55, to a glass plate (which has a reflection index of about 1.52) with the help of a linkage fluid. The application of fluid smoothes the skin surface and decreases reflection. Therefore, under good conditions, structures in the upper reticular dermis can be viewed. As linkage fluid, either disinfectant solutions or several types of oil can be used. In areas where burning can be a problem, such as the eyes, mucosal surfaces, and lesions with a verrucous surface, we prefer ultrasound gel.

The glass plate of the dermatoscope needs to be regularly and carefully disinfected, because it can be the source of nosocomial infections.\textsuperscript{14}

**DIFFERENTIAL DIAGNOSIS OF PIGMENTED SKIN LESIONS**

Our approach to pigmented skin lesions involves the multi-step algorithmic method shown in Figure 1. The essence of this algorithmic approach includes first deciding if a lesion is melanocytic and then determining the malignant potential of melanocytic lesions. If the diagnosis of a melanocytic skin lesion is made, it can then be evaluated by using the ABCD rule of dermatoscopy. The resultant total dermatoscopy score (TDS) is used to classify the lesion as benign, suspicious, or malignant. If the TDS falls into the benign or suspicious range, one must still check if additional criteria for malignancy are present (vascular pattern, regression, pseudopods) or if location-specific criteria have to be considered.

When determining whether a pigmented skin lesion is melanocytic or nonmelanocytic, we use the algorithm shown in Figure 2. In the first step, it is important to determine whether the 3 structural components—pigment network, pigmented aggregated globules, and branched streaks—are present. These structural components prove the melanocytic origin of a skin lesion if the color and distribution are characteristic. The network should have regular honeycomb-like openings and a brown-to-black color. The globules should be aggregated and brown, blue-gray, or black in color. Milky red globules are not sufficient criteria.

![Fig 1. Flow chart for the dermatoscopic diagnosis of pigmented skin lesions](image)
because they can be confused with the red lagoons of eruptive hemangiomas and angiokeratoma.

The streaks must be branched and also be brown, blue-gray, or black. Linear pigmented structures (pseudostreaks) sometimes seen in papillomatous pigmented lesions and seborrheic keratoses must be differentiated from branched streaks. These pseudostreaks are due to the aggregation of pigment within the sulci of a convoluted surface. They can be distinguished from the typical branched streaks because they are broader and usually have only small branches.

Dermatofibromas are usually easy to identify clinically as firm cutaneous nodules. They may represent an exception to the algorithm, because with dermatoscopy, they show a peripheral pigment network or branched streaks. This is explained by their tendency to have long and heavily pigmented rete ridges, especially at the periphery. Another exception is supernumerary nipple in which acanthosis with increased basal pigmentation leads to a pigment network.

In the second step of the melanocytic algorithm, when typical structural components (network, streaks, and globules) are absent, one must decide if the steel blue pigmentation typical for a blue nevus is present. Within the steel blue pigment of a blue nevus, other structures, such as blue globules and dots, can be observed. Intradermal metastases of a malignant melanoma can also present with homogenous steel blue areas, so that if questions remain, histologic evaluation may be needed.

In the third step, one searches for comedo-like pseudofollicular openings and horn pseudocysts, which are the most important primary criteria for seborrheic keratoses (Fig 3). Because pseudofollicular openings and horn pseudocysts may be also present in papillomatous melanocytic nevi, it is very important in the diagnosis of seborrheic keratoses that other criteria for a melanocytic lesion (network, streaks, or aggregated globules) are absent. The gyri and sulci pattern may also be seen in seborrheic keratoses, in flat lesions, the fingerprint-like pattern, moth-eaten border, or jelly-like border may be observed.

In the fourth step, hemangioma and angiokeratoma are diagnosed by the presence of red, blue-red, and red-black lagoons.

In the fifth step, pigmented basal cell carcinoma must be considered. Blue-gray and brown ovoid and larger structures at the periphery are quite typical, especially if they have a maple leaf pattern. In addition, the vascular patterns of large superficial arborizing vessels of varying calibers of many fine telangiectases both support the diagnosis. A pigmented basal cell carcinoma may also have scattered slate gray ovoid or larger areas. Sometimes they exhibit a spoke-wheel pattern. According to Menzies, basal cell carcinomas are likely to have superficial ulcerations at an earlier stage than malignant melanoma; this phenomenon can be helpful as a secondary criterion (Fig 4).

After this diagnostic step, the pigmented skin lesions that cannot be positively identified remain. In most cases, these lesions are of melanocytic origin and must be evaluated with regard to their malignant potential.

**Differential Diagnosis of Melanocytic Lesions**

*Recognition of Benign Melanocytic Lesions With Special Patterns*

Before using the ABCD rule of dermatoscopy, several melanocytic skin lesions can be separated by identifying special patterns. Included in this group are the following types of melanocytic nevi—globular, papillomatous, pigmented spindle cell (Reed), pigmented Spitz, congenital, recurrent and agminate nevi—as well as nevus spilus. While the ink spot lentigo is not a melanocytic lesion, it too should be considered at this stage.

*Melanocytic nevi with globules* have heavily pig-
Pigment Pattern of Melanocytic Lesions on Palms and Soles

Benign melanocytic lesions
- Parallel furrow pattern
- Lattice-like pattern
- Pattern with globules
- Fibrillar pattern
- Lattice-like pattern with dots and globules
- Ladder pattern

Suspicious melanocytic lesions
- All benign patterns with numerous irregularly distributed dots and globules

Malignant melanomas
- Parallel ridge pattern
- Inverse of furrow pattern
- Bizarre pattern
- Milky red and/or numerous vessels and brown areas

Figs 3-5, 7-9.
mented nests of melanocytes in the lower epidermis and the papillary dermis. They produce aggregated globules in a cobblestone pattern. These globules may be arranged in an asymmetrical pattern and have several different colors because of the variable distribution of melanin. Thus, the ABCD rule of dermatoscopy can lead to a high score. The homogenous nature of the globules and the overall architecture allow the correct diagnosis of a melanocytic nevus.

Papillomatous melanocytic nevi, also known as Unna nevi, even at a glance, have a distinctive clinical appearance with a uniform architecture. The border is frequently lobulated with numerous convex or half-moon structures. The vascular pattern can also be helpful, because it is characterized by comma-shaped, arciform, and linear vessels lying deeper in the skin and thus appearing blurred.

Spitz nevi and pigmented spindle cell (Reed) nevi are only readily recognizable with the dermatoscope when they are heavily pigmented. Pigmented spindle cell nevi and pigmented Spitz nevi have similar dermatoscopic characteristics and cannot be separated. With the dermatoscope, they show one of the following characteristic zoned patterns: globular (central dark or central light), starburst (central dark or central light), reticular, homogenous or atypical (Fig 5). Lesions with atypical patterns cannot be distinguished from malignant melanoma and must be excised.

Larger congenital melanocytic nevi when examined dermatoscopically often show a structureless basic pattern with scattered islands that display a network, globules, dots, or branched streaks. These islands themselves are relatively symmetrical in architecture and color. Because the ABCD rule of dermatoscopy was developed with small melanocytic nevi, it does not provide help in studying larger nevi. If smaller congenital melanocytic nevi have rete ridges with variations in shape or pigment content, strongly pigmented dermal nests or an increase in melanophages, all of which may combine to produce blue-gray surface tones, then they may yield high dermatoscopy scores and a false diagnosis of malignancy. Such lesions are often also clinically difficult to interpret, if the history does not confirm presence since birth with no change other than a proportional increase in size.

When dealing with nevus spilus (speckled lentiginous nevus) or an agminate melanocytic nevus (such nevi consist of several common, blue or Spitz nevi grouped together), one must examine each darker lesion individually. They are usually symmetrical and uniformly pigmented. When pigment is in the upper dermis, they may have a blue-gray color. If a given lesion appears irregular, follow-up or excision is recommended.

When melanocytic nevi are not completely excised, they may recur (or more accurately, persist) and produce a clinical picture that can resemble a malignant melanoma. The distinction is not only difficult clinically, but also dermatoscopically and even microscopically. Thus, the history is crucial. The more polymorphous the dermatoscopic pattern, the more likely the diagnosis of a recurrent malignant melanoma becomes.

The ink spot lentigo, also known as the sunburn lentigo, has increased melanin but a normal number of melanocytes. The name is apropos, as the lesion clinically resembles a drop of ink on blotting paper. On dermatoscopic examination, these lesions have thick lines and a highly irregular grid pattern. Because of their asymmetry, these lesions often achieve high dermatoscopy scores. Generally, there are only brown and black colors without a vascular pattern. If multiple colors are...
Asymmetry

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<th>Score</th>
<th>Description</th>
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<tr>
<td>0–2</td>
<td>In zero, one, or two axes Color, texture, and shape</td>
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Border

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<th>Score</th>
<th>Description</th>
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<tbody>
<tr>
<td>0–8</td>
<td>Abrupt cut-off of pigment pattern in 0–8 segments</td>
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Color

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<th>Score</th>
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<tr>
<td>1–6</td>
<td>Presence of up to six colors (white, red, light brown, dark brown, blue-gray, black)</td>
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Differential structures

<table>
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<tr>
<th>Score</th>
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<tr>
<td>1–5</td>
<td>Presence of network, structure-less areas, dots, globules, and streaks</td>
</tr>
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Fig 6. ABCD rule of dermatoscopy (Reprinted with permission32).

present or a vascular pattern is seen, one must think of an early malignant melanoma. Another clue to the correct diagnosis is that ink spot lentigines are often on the upper trunk. Sometimes clear distinction between an ink spot lentigo and a malignant melanoma cannot be made with dermatoscopy. Then excision is necessary.

**ABCD RULE OF DERMATOSCOPY**

After excluding these special types of melanocytic nevi, we can use the ABCD rule. We developed this rule to quantitatively address the one crucial question in dermatoscopy of melanocytic skin lesion—is a given lesion benign, suspicious (borderline) or malignant? This approach is based on the 4 criteria— asymmetry, border, color and differential structure—which are combined to produce the TDS by using a linear equation (Fig 6). The individual scores for asymmetry, border, color, and dermatoscopic structures are multiplied by the coefficients 1.3, 0.1, 0.5, and 0.5, respectively, and then combined. With this TDS, a grading of the lesions is possible with respect to their malignant potential. Binder et al showed the usefulness of the ABCD rule of dermatoscopy, especially in enabling relatively inexperienced operators to more accurately assess melanocytic lesions. In the following, each criterion is explained separately.

In judging the asymmetry, the lesions are bisected by two 90° axes that were positioned to produce the lowest possible asymmetry score. The asymmetry has to be calculated according to the distribution of colors and structures on either side of each axis, and not solely by contour, as in the clinical ABCD rule. If asymmetry is absent with regard to both axes, the score is 0. If there is asymmetry on one axis, the score is 1. If there is asymmetry on both axes, the score is 2. We found in our original data set that 96% of malignant melanomas had an asymmetry score of 2 compared to only 24.2% of benign melanocytic nevi. Of the remaining melanocytic nevi, 61.3% had an asymmetry score of 1, and 14.5% had a score of 0. The lesions frequently appear symmetrical in the conventional macroscopic image, and only under a dermatoscope, when colors and structures can be more precisely evaluated, is asymmetry evident.

The evaluation of the border score is predicated on whether there is a sharp, abrupt cut-off of pigment pattern at the periphery of the lesion or a gradual, indistinct cut-off. For analysis, the lesions are divided into eighths. Thus, the maximum border score is 8 and the minimum score is 0. In our investigation of melanocytic nevi, the border score was 0 in 60% and higher than 4 in only 10%. In contrast, the border score in malignant melanoma was predominately between 3 and 8. In the practical application of the border score, reproducibility is sometimes low, because it can be difficult to evaluate whether cut-off is abrupt or not.

In determining the color score, a total of 6 colors can be identified with a dermatoscope—white, red, light brown, dark brown, blue-gray, and black. Four colors come from the distribution of melanin (light and dark brown from melanin in the junctional zone, black from melanin in the upper granular layer or stratum corneum and blue-gray from melanin in the papillary dermis). White is caused by regressive changes and red is caused by inflammation or neovascularization. White is only chosen if the area is lighter than the adjacent normal skin. The values for the color score range from 1 to 6. Just as with asymmetry, the dermatoscope reveals a wider range of colors than seen with the naked eye. In our original data set, 56% of melanocytic nevi had 2 colors, 29% had 3 colors, and only 10% had more than 3 colors. Malignant melanomas showed 3 or more colors 85% of the time, and 5 or 6 colors 40% of the time.

For evaluation of dermatoscopic (also known as differential) structures, 5 main features are considered: structureless areas, pigment network, branched streaks, dots, and globules. The higher the polymorphism of the structural components,
the higher the chance of the lesion being a malignant melanoma. In more than 90% of melanocytic nevi, 3 or less structural components were present, whereas in more than 73% of malignant melanomas 4 or more structural components were found. Few, if any, structural components can be seen with the naked eye, but they can be recognized by a trained observer using a dermatoscope. To be counted in our ABCD rule of dermatoscopy, structureless areas must be larger than 10% of the total lesion. Dots and branched streaks are counted if there are more than 2, and globules are counted if there are more than 1.

An accurate distinction between benign and malignant melanocytic lesions can be made if the TDS is used. In the training set, the specificity was 90.3% and the sensitivity was 100%, which indicates that all malignant melanomas displayed a dermatoscopy score higher than 5.45, and only 9.7% of melanocytic nevi were falsely considered malignant. In the test set, diagnostic accuracy was 92.2%, sensitivity was 97.9%, and specificity was 90.3%, which confirms the high diagnostic value of the ABCD rule of dermatoscopy. The rule is further refined by labeling as suspicious of malignancy all lesions whose dermatoscopy score fails between 4.75 and 5.45, and excising these lesions or following them closely. As with all investigative and diagnostic methods in medicine it is important that the investigator has sufficient experience with the technique.

If the TDS falls into the benign or suspicious range, one must still check if additional criteria for malignancy are present. We have identified 3 additional clues—vascular pattern, regressive areas and pseudopods.

Three vascular patterns may be important for the diagnosis of malignant melanoma. First, an irregular polymorphous pattern of small vessels running both parallel and vertical appears as red lines and small red dots simultaneously under the dermatoscope. Second, milky red or blue red globules and larger areas that are fuzzy or unfocused reflect well-vascularized tumor nodules. Third, polypoid malignant melanoma may display bizarre patterns of surface vessels resembling irregular hairpin-like vessels. Milky red or blue-red areas are especially valuable in the diagnosis. They allow a definite diagnosis when they appear along with other findings which unequivocally point to a melanocytic lesion. Occasionally one only finds a few dark dots or a small brown patch as the last remaining sign of a melanocytic lesion; these changes may then be the only clue to a melanocytic origin.

Areas of regression are most common in superficial spreading melanomas, but are also seen in lentigo maligna melanomas and acral lentiginous melanomas. Dermatoscopic examination reveals white scar-like areas, which may be associated with milky red, red-blue or blue-gray areas. Regressive areas must be whiter than the surrounding skin and have to be differentiated from melanocytic nevi, which may envelop or surround areas of normally pigmented skin (pseudoregressive areas).

We call asymmetric and irregular extensions from branched streaks into the adjacent skin pseudopods. These pseudopods are rare, but then almost exclusively seen in malignant melanoma.

ADDITIONAL LOCATION-SPECIFIC CRITERIA FOR MALIGNANCY

On the face, palms, soles and mucosa, additional location-specific criteria for malignancy must also be considered.

Because of the rete ridges being in the face much flatter than on the trunk, dermatoscopic examination of facial skin reveals a distinct pigment network that is known as a pseudonetwork. This feature is seen in both melanocytic and nonmelanocytic lesions. The distinction between a flat seborrheic keratosis (lentigo senilis) and a lentigo maligna (or even lentigo maligna melanoma) is of special importance on the face. A multivariate analysis showed that asymmetrical pigmented follicular openings, blue-gray dots and globules, as well as dark brown and black annular streaks (the annular-granular pattern) strongly suggest a lentigo maligna (Fig 7). Horn pseudocysts, fingerprint-like pattern, moth-eaten border, and jelly sign indicate a flat seborrheic keratosis. Both a pigmented actinic keratosis and a benign lichenoid keratosis can mimic a lentigo maligna.

On the palms and soles, melanocytic nevi tend to have striped streaks parallel to the papillary tips, known as a parallel-furrow pattern. In other instances, the pigment both follows and crosses the ridges producing a lattice-like pattern. Less often numerous finely pigmented parallel filaments are found, arranged without regard to the furrows, producing a fibrillar pattern. In malignant mela-
nomas, the vascular pattern and areas of regression are good clues, as are 2 other pigment patterns—inverse parallel ridge and bizarre. In addition, irregularly distributed dots or globules can point to a malignant melanoma (Fig 8).

Mucosal melanotic macules are pigmented lesions typically seen on the lips, glans penis, and female genitalia. They are often clinically alarming, especially on the genitalia where they are frequently misinterpreted by nondermatologists.

In our experience, benign lesions are characterized by aggregated light and dark brown to slate gray globules, fingerprint patterns with narrow parallel lines as in lentigo senilis, and broader track-like pigmentation interrupted by dots and globules. In genital regions small regularly pigmented circles can be found. If such lesions become asymmetric with heterogeneity of both color and structures and an abrupt cut-off of the pigmented pattern at the periphery, biopsy is required to rule out a malignant melanoma. Malignant lesions may also show asymmetric circular pigmentation, larger blue-gray areas or irregularly distributed globules and dots.

SPECIAL CHARACTERISTIC FINDINGS AND VARIANTS OF MELANOCYTIC NEVI

Common melanocytic nevi can be classified according to the 3 characteristic basic structural components: network, globules, and structureless areas. Melanocytic nevi of the mixed type are more frequent than those in which one of the basic patterns predominates (Fig 9). In these mixed lesions, 2 or all 3 of the basic patterns are present simultaneously. Additionally, dots (perhaps initial globules), streaks, occasional pseudofollicular openings, horn pseudocysts, and vascular structures can be present. The presence of network structures is due to regular, long and heavily pigmented rete ridges. Within structureless areas, the rete ridges are either shorter or less pigmented. Heavily pigmented melanocytic nests in the lower epidermis and within the papillary dermis are responsible for the globular pattern.

In papillomatous melanocytic nevi one may find a globular pattern, but structureless areas may coexist or predominate on dermatoscopy.

Melanocytic nevi with a papillomatous component at the edge may present with a pigment network, which is due to heavily pigmented rete ridges with intraepidermal melanocytic nests and proves their melanocytic origin. If these papillo-
turn to baseline at day 28. During suberythemal UVB therapy, unprotected melanocytic nevi may become both darker and more irregular. Morphological changes have been identified after holidays at sunny sites. Seasonal differences have also been documented when patients examined in the summer or winter months were compared. This has to be considered when follow-up examinations are performed.

The term “dysplastic nevus” is both clinically and histologically controversial. Some authors reject the term outside the setting of familial dysplastic nevus syndrome. Others adhere to the concept that dysplastic nevi are transitional lesions between normal melanocytic nevi and malignant melanomas, and that some of them progress to become malignant melanoma. The greatest problem in the discussion of dysplastic nevi is that criteria have not been agreed on for either their clinical or their histological diagnosis. Regardless of the existential question of whether dysplastic nevi constitute a true entity, a form of risk analysis for suspicious melanocytic lesions is clinically necessary and possible with the ABCD rule of dermatoscopy. Our paradigm regards melanocytic lesions with TDS ranging from 4.75-5.45 to be at the threshold for the diagnosis of malignant melanoma. Unless they belong to the exceptions to the ABCD rule of dermatoscopy because of special features or location-related changes, these lesions should be followed for any change or excised. Those melanocytic nevi histologically typed as dysplastic by us exhibit asymmetry along one axis or both axes, as well as a higher average number of different colors and structures than common melanocytic nevi (Fig 10). Therefore, they have higher TDS. According to our studies the TDS for nevi judged histologically to be dysplastic by us range from 4.3-5.8. We rarely diagnose dysplastic nevi histologically; such lesions must show at least some features of malignant melanomas.

IMPORTANT DERMATOSCOPIC CHARACTERISTICS OF MALIGNANT MELANOMAS

The majority of malignant melanomas are histologically classified as superficial spreading malignant melanomas (SSM). Larger SSM dermatoscopically exhibit asymmetry along two axes as well as a large number of different colors and structural components, resulting in a high TDS. The color white is only considered present if the light areas within the lesion are lighter than the surrounding skin, indicating regression of malignant melanoma. Not all SSM show primary criteria (network, aggregated globules, and branched streaks) for melanocytic lesions. But even in the absence of primary criteria for melanocytic lesions, it is possible to diagnose melanocytic lesions by default according to our melanocytic algorithm if criteria for seborrheic keratoses, hemangiomas, and basal cell carcinomas are also absent. The milky red and blue-red globular pattern, together with the white areas arising in this otherwise bland structureless lesion (Fig 11), are indicative of a malignant melanoma, although a regular pigment network and branched streaks are absent. The milky red globules and background represent neovascularization and malignant growth.

The dermatoscope is of special value in cases where one cannot determine macroscopically whether a lesion is malignant, as in Figure 12. In many such lesions, an unequivocal diagnosis of malignant melanoma can be made preoperatively by using the ABCD rule of dermatoscopy. In our hands, the additional criteria of milky red or blue-red areas and globules are extremely useful for this type of malignant melanoma, which in the literature have sometimes been regarded as featureless and impossible to diagnose by dermatoscopy.

Nodular malignant melanoma may present with 2 different dermatoscopic patterns. Paradoxically, the thicker tumors are often more difficult to diagnose than the thinner ones. In thinner lesions, a pagetoid pattern due to atypical melanocytic cells in the epidermis and an increased amount of pigment in the upper spinous and horny layer may be seen dermatoscopically as different structural components such as branched streaks, dots, and globules on a structureless background. Different colors appear between black (pigment in the stratum corneum or upper spinous layer) and blue-gray (pigment in the papillary dermis) (Fig 13). In the majority of nodular melanomas, these multiple epidermal and dermal changes are sparse, with only a few colors and structures seen. These lesions frequently present with a TDS that is only slightly higher than or even below 5.45 (Fig 14). In these cases, it is important to search for subtle structural components and recognize the additional criteria for malignancy—milky red or blue-red globules and areas as well as signs of regression.
Fig 10-15.
Approximately 25% of malignant melanomas develop in association with a preexisting melanocytic nevus. Under a dermatoscope the difference between the benign and malignant parts can be striking. The dermatoscope is a powerful tool when faced with a brown macular lesion in which darker areas appear, either in a common melanocytic or even in a congenital melanocytic nevus. In agminate melanocytic nevi and nevus spilus, a heightened suspicion of malignant melanoma should occur if milky red or white areas are found.

Amelanotic parts in malignant melanomas are characterized by polymorphous vascular patterns and/or milky red or blue-red areas. Sometimes during tumor progression they may lose almost all of their pigment and diagnosis can be only suggested if subtle remnants of pigment are seen dermoscopically or if the patient gives the clear history of a pre-existing pigmented lesion in this location. Red SSM are very difficult to interpret by both clinical and dermoscopic findings. These macular lesions may clinically be completely amelanotic and the differential diagnosis includes Bowen disease, superficial basal cell carcinoma, and localized dermatitis. With the dermatoscope sometimes the diagnosis of malignant melanoma can be suggested when a bizarre and polymorphous vascular pattern and white scar-like areas are combined with features of a melanocytic lesion (network, branched streaks, aggregated globules or brown colors only). Not infrequently melanomas with a large amelanotic component are located on acral sites, where they can be mistaken for an irritated common wart, pyogenic granuloma, or granulomatous response to an ingrown nail.

Metastatic malignant melanomas (Fig 15) are characterized by aggregations of red-brown globules that indicate highly vascularized nests of cells. The diagnosis cannot be made definitively by dermoscopy, because a melanocytic nevus with a globular pattern must also be considered. In contrast to the globules of a melanocytic nevus, those in a metastatic lesion are of irregular size, vary in color, are predominantly blue-gray and milky red, and are not sharply demarcated. When a steel blue nodule is identified in a patient with a malignant melanoma, the distinction between blue nevus and metastasis can be extremely difficult. Sometimes the history helps greatly, if the patient can state with certainty that the lesion is brand-new or has been present for many years. In cases where the history is uncertain, multiple lesions are found or a bizarre pattern is seen dermoscopically, we always perform an excision.

CONCLUSION

In our experience, dermatoscopy is very helpful and reliable in the discrimination between malignant melanoma and nonmelanocytic lesions, in the detection of initial malignant melanoma and the risk analysis of melanocytic nevi. Nevertheless, dermatoscopic evaluation should never be seen as final, but always looked at together with the patient's personal and family history and, if available, previous assessments of the lesion. Special attention must be paid to a history of any change in present lesions or the onset of a new lesion.

Further developments in the field of dermoscopy include videodermatoscopy, teledermatoscopy, and digital image analysis.
scopy and computer-aided dermatoscopy. All of these methods have been reviewed in detail.

Using videodermatoscopy the current and the previous images of a lesion can be directly compared on the screen, which can enhance the diagnostic accuracy. Teledermatoscopy and computer-aided dermatoscopy allows one to include the experience of an expert or a validated data base for the diagnostic decision. Despite all these technical advances, in the end the dermatologist is responsible for the diagnostic quality. All dermatologists caring for patients with pigmented skin lesions can profit from knowledge in dermatoscopy.

REFERENCES