Pigmented Lesions in Children

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ABSTRACT

Pigmented lesions in childhood can pose significant diagnostic and therapeutic challenges. This article examines the most common pigmented lesions encountered in childhood. Special emphasis is placed on the diagnosis and management of congenital melanocytic nevi, acquired melanocytic nevi, clonal nevi, halo nevi, atypical melanocytic nevi, Spitz nevi, recurrent nevi, childhood melanoma, blue nevi, speckled lentiginous nevi, and other melanocytic nevi such as nevus of Ota and nevus of Ito. Proper diagnosis and an understanding of the natural history of pigmented lesions in children are essential for successful outcomes.

KEYWORDS: Pigmented nevus, pediatric, Spitz nevus, congenital nevus, melanoma

In children, like adults, pigmented lesions can pose significant diagnostic and therapeutic challenges. Fortunately, malignant melanoma is exceedingly rare in childhood and many pigmented lesions can be followed safely without surgical management. Nonetheless, childhood presents a window of opportunity whereby benign pigmented lesions that possess significant future risk for malignant transformation or future cosmetic concerns may be safely removed. Proper diagnosis and an understanding of the natural history of pigmented lesions in children are essential to successful clinical outcomes. This article reviews the most common pigmented lesions encountered in childhood and discusses a practical approach to their management.

BACKGROUND

The hue of a pigmented lesion is determined by the type and amount of pigment as well as the location of the pigment within the skin. For instance, dermal pigmentation appears gray-blue because shorter wavelengths of light, such as blue and violet, are reflected to the surface of the skin, while longer wavelengths such as red, orange, and yellow are not reflected (Tyndall phenomenon).¹ In patients with light skin, epidermal pigment is enhanced

and appears darker when exposed to a Wood's lamp. A Wood's lamp can be useful to detect subtle pigmented lesions with superficial epidermal pigment, such as café au lait macules and ephelides. Pigmented lesions may occur in the skin due to exogenous sources such as medications, tattoos, and tinea nigra (Table 1). The most common pigmented lesions in childhood are pigmented melanocytic nevi, seen in virtually all children.²

DERMOSCOPY

In the past decade, several noninvasive techniques allowing more accurate clinical diagnosis of pigmented lesions have been developed. Dermoscopy, also known as epiluminescence microscopy, is one such noninvasive in vivo technique. Using this technique, oil or alcohol solution is applied to the surface of the dermatoscope to improve the clarity of the magnified image and subsurface structures.^{3,4} Dermoscopy is very helpful to distinguish melanocytic versus nonmelanocytic lesions, and pattern analysis can be employed to assist in differentiating benign from malignant melanocytic lesions.⁵

Algorithms and checklists, such as Menzie's method, the seven-point method, pattern recognition, and the ABCD algorithm, have been shown to improve

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Table 1 Causes of Skin Pigmentation

Hemosiderin (e.g., ferric subsulfate "Monsel's solution")
Tattoo pigment (e.g., graphite)
Lipofuscin
Silver (e.g., silver nitrate)
Gold
Mercury
Arsenic
Lead
Aluminum
Bismuth
Medications
Minocycline
Tetracycline
Antimalarial drugs
Phenothiazines
Clofazimine
Homogentisic acid (e.g., ochronosis)
Infection
Tinea nigra

diagnostic accuracy.^{6,7} Like any other diagnostic technique, dermoscopy requires training to master the skill. Studies have shown that diagnostic accuracy may actually decrease with untrained examiners.^{8,9} Nonetheless, we provide Table 2 as a brief introductory overview of the dermatoscopic patterns utilized in the evaluation of pigmented lesions.

Pigmented Melanocytic Nevi

Pigmented melanocytic nevi are hamartomatous collections of melanocytes referred to as nevus cells. Nevus cells are thought to be derived from epidermal

melanoblasts or dermal Schwann cells.¹⁰ The precise mechanism explaining how nevi develop in the skin is not known and has been the subject of research for over 100 years. In 1893, Unna proposed the Abtropfung hypothesis, stating that nevus cells first develop in the epidermis and then "drop off" into the dermis.¹¹ The Abtropfung hypothesis suggests that all nevi begin as flat junctional nevi. The nevus cells then drop off into the dermis and develop into raised pigmented compound nevi. As nevus cells regress, dermal skin colored nevi are formed. An opposing Hochsteigerung (upward climb) hypothesis contends that neural crest-derived nevus cells track along nerve fibers, extending from paraspinal ganglia, and contribute to postnatal tissue maintenance. Nevi that recur after partial removal support the upward climb hypothesis.¹¹ A third dual-origin theory suggests that epidermal nevus cells are derived from epidermal melanoblasts and dermal nevus cells are derived from dermal Schwann cells.¹² Recent evidence indicates that the bulge area of mouse adult hair follicles contains pluripotent neural crest stem cells and may be a source of melanocytes needed for postnatal tissue maintenance.¹³ These pluripotent melanocytes are probably important for wound healing and repigmentation in vitiligo.^{14,15}

Congenital and Acquired Melanocytic Nevi

Approximately 1% of newborns have melanocytic nevi at birth (congenital melanocytic nevi [CMN]).¹⁶ All other nevi develop after birth (acquired melanocytic nevi [AMN]). AMN first appear at about 1 year of age, peaking in number during the second or third decades of life,¹⁷ and disappearing by the seventh to ninth decades.¹⁸ The underlying mechanism for this "life cycle" of nevi is not clear. Most AMN appear gradually as

Table 2 Dermatoscopic Patterns Utilized in the Evaluation of Pigmented Lesions

Criteria	Benign Pigmented Nevi	Melanoma	Seborrheic Keratosis
Pigment network	Uniform, regularly meshed, homogeneous in color, and thinning at the periphery	Black, brown, or gray thickened and irregular network, streaks, and pseudopods	Network-like structure Ridges and furrows Finger-like pattern Moth-eaten border
Dots/globules	Regular brown or black	Irregular or peripheral black, brown, blue-gray (pepper-like)	Comedo-like openings
Blue-white veil	Usually absent	Present, may have "ground glass" appearance	Absent
Vascular structures	Some pigmented lesions can have regular vascular pattern	Atypical vascular pattern such as linear or dotted vessels can be a sign of neovascularization.	Hairpin blood vessels
Regression structure	Usually absent	Present, white scar-like areas or bluish-white areas	Absent
Milia-like cysts	Some congenital and papillomatous melanocytic nevi	Absent	Present

children age; however, multiple nevi may appear suddenly or become more prominent in response to a variety of factors including sun exposure, cortisone, corticotropin, growth hormone, chemotherapy, and immunosuppression.¹⁹

The number of total body nevi positively correlates with melanoma risk.²⁰ Ultraviolet (UV) light represents the primary environmental factor, increasing the number of total body nevi.^{21,22} Several studies indicate an association between sunburns, particularly before age 20, and larger numbers of nevi.²²⁻²⁴ Data indicate that even mild to moderate sun exposure in early life is sufficient to increase total body nevi.^{22,24} A Swedish study by Stierner showed that repeated UVB irradiation can increase nevi numbers, not only in exposed but also in unexposed skin, suggesting a systemic effect of UV radiation on nevogenesis.²⁵ The ability of sunscreens to prevent nevi formation is not well understood.^{26,27} However, sunscreens have been shown to prevent sunburns and thereby decrease the risk for malignant melanoma.²⁸

Congenital Melanocytic Nevi

In the developing fetus, CMN are thought to arise between the 5th and 24th weeks of gestation as a result of dysregulation in normal melanoblast development. Some authors suggest that certain CMN may not fully pigment until months or even years later and, thus, may not become apparent until later in life. Classifying a nevus as congenital merely by presence or absence at birth may not be completely accurate. CMN can be subclassified according to the largest diameter: small (less than 1.5 cm), medium (between 1.5 and 19.9 cm), and large (20 cm or greater) (Fig. 1).¹⁶ Bittencourt et al showed that malignant potential correlates positively with size.²⁹

As a group, CMN are thought to carry an increased risk for malignant melanoma. Small, banal-appearing CMN have a risk for malignant melanoma

similar to that of an acquired nevus.³⁰ Hence, the approach to management of small CMN is the same as the approach to AMN. Small congenital nevi do not require prophylactic removal, but they should be followed closely, looking for changes in shape, color, and diameter. Intermediate-sized CMN carry an unknown risk for malignant transformation; however, this risk is probably related to the size of the nevus and is between the baseline risk of melanoma and the melanoma risk of a large CMN.¹⁶ Large CMN occur with an incidence of 1 in 20,000 live births and are thought to carry a 2.9% lifetime risk for malignant melanoma, although the prevalence of malignant melanoma associated with large CMN has varied considerably.^{31,32} Evidence points to an increased risk of malignant transformation during the first 3 to 5 years of life.^{33,34} Approximately half of the malignancies that have occurred in large CMN developed in the first 3 years of life, 60% by childhood, and 70% by puberty.³⁵ Therefore, decisions regarding prophylactic removal should be made early in life. In addition to size of the lesion, other important factors to consider include location, number of satellite nevi, and involvement of the leptomeninges. Data from a large registry at New York University suggest that large CMN located on the extremities carry a much lower risk of malignant transformation than centrally located large CMN on the torso. Infants with large CMN and more than three satellite nevi are at increased risk for malignant melanoma even though there does not appear to be a risk for melanoma occurring within the satellite nevi themselves. Moreover, two thirds of associated melanomas arise deep within the dermal and subcuticular portion of the nevus, retroperitoneum, and central nervous system (CNS), making early detection difficult.^{36,37}

Involvement of the CNS is referred to as neurocutaneous melanosis and is seen more commonly in infants with large CMN. Neurocutaneous melanosis places infants at risk for CNS sequelae, such as seizures and hydrocephalus.^{33,38} DeDavid et al reviewed the records of 117 patients with large CMN enrolled in the NYU registry and 172 patients from the literature.³⁹ Among 289 patients with large CMN, 33 showed CNS involvement, and nearly all affected children had pigmented nevi on the head and neck or dorsal spine area. Children affected with neurocutaneous melanosis usually show signs and symptoms before they reach 2 years of age.

Management of Congenital Melanocytic Nevi

Treatment decisions should be tailored to individual patients, taking into account lesion size, location, appearance, and leptomeningeal involvement. Small, banal-appearing CMN do not require prophylactic removal; however, they should be evaluated closely for changes in lesion asymmetry, border, color, and

Figure 1 A large congenital melanocytic nevus showing increased hair growth.

diameter. Intermediate-sized CMN may require prophylactic excision, especially if lesions appear atypical.⁴⁰ Prophylactic removal should be considered before the teenage years because risk for malignant melanoma is higher in postpubertal children. Many older children tolerate excision with local anesthesia, and with modern anesthetics, general anesthesia is safe in infancy.⁴¹ Some surgeons prefer to remove larger CMN located on the scalp during infancy because scalp skin is much more pliable early in life. Moreover, infants do not remember the procedure and do not experience lasting psychological effects.

Prophylactic removal of large CMN continues to be an area of considerable controversy. Current evidence suggests that prophylactic removal does not alter melanoma risk or lessen neurocutaneous melanosis. Often, infants undergo multiple costly surgical procedures, suffer significant postoperative complications, and, in the end, are left with a poor cosmetic result (Fig. 2). Nonetheless, in selected children, surgical interventions can significantly improve the cosmetic appearance and lessen the psychological impact related to CMN. Modalities such as complete surgical excision, curettage, dermabrasion, laser therapy, and chemical peeling may be used alone or in combination to improve the ultimate

Figure 2 This boy underwent partial excision of a large congenital nevus and has residual scarring and swirling pigmentation.

appearance of large CMN.^{42,43} In our center, we perform magnetic resonance imaging (MRI) scans of the head and spine in infants with centrally located large CMN where prophylactic excision is considered. Many authors recommend CNS imaging studies for all infants with large CMN. In one study, 30% of asymptomatic patients with large CMN were found to have leptomeningeal melanosis, suggesting that the incidence of CNS involvement is high. In 71% of infants with abnormal MRI scans, the CMN covered much of the spinal area and satellite nevi were seen on the scalp.⁴⁴ Large CMN in these areas should prompt one to consider CNS imaging studies.

Acquired Melanocytic Nevi

The most common type of melanocytic nevus is the acquired melanocytic nevus. AMN contain melanocyte nests located in the dermal-epidermal junction (junctional nevus), in the dermis (dermal nevus), or in both the dermal-epidermal junction and dermis (compound nevus). Junctional nevi appear as oval to round macules. The borders tend to be sharply margined and the color uniform. Dermal nevi are round, firm, skin-colored papules and are more common in adults than children.⁴⁵ Compound nevi are tan to brown papules and are common in childhood. Often, AMN vary substantially in appearance. They may develop a verrucous surface and some become pedunculated. Scalp nevi frequently develop a ring appearance with a darker center. Nevi occurring in the nail matrix form pigmented streaks or melanonychia striata. Nevi on the mucous membranes appear as tan to black macules.

AMN are benign lesions that can be safely followed in most instances. Patient's age, location, lesion type, and whether or not change is occurring are factors to consider in the surgical management of AMN. Many children, especially during early adolescence, want nevi removed. As a rule, these patients should be discouraged from having moles removed for cosmetic reasons unless the nevus is so troubling that it is impeding normal adolescent psychosocial development. Other reasons to remove AMN include atypical appearance and irritation.

In the following sections, we describe AMN with unique clinical and histological characteristics.

Clonal Nevus

Originally identified in 1994 by Ball and Golitz, the "clonal nevus" is a benign nevus containing a focal area of proliferating pigmented dermal melanocytes.⁴⁶ Clonal nevi are also referred to as inverted type A nevi and nevi with focal clonal hyperplasia. Clinically, a clonal nevus appears tan to light brown in color with a blue-gray to blue-black focal area of pigmentation⁴⁷ (Fig. 3). In 70% of the clonal nevi reported by Bologna et al, there was an

Figure 3 A clonal nevus showing the dark focus of pigmentation.

increase in the melanin content of epidermal melanocytes or keratinocytes or both and an increased number of superficial dermal melanophages.⁴⁸ Molecular studies reveal a 50% increase in the p53 mutation in melanocytes located in the focal area of pigmentation and absence of the p53 mutation in adjacent melanocytes.⁴⁶ To date, clonal nevi are considered benign lesions; however, in our center we biopsy and completely excise clonal nevi.

Halo Nevus

A halo nevus, also known as leukoderma acquisitum centrifugum, is a melanocytic nevus surrounded by depigmentation. Halo nevi are benign melanocytic nevi occurring in 1% of the general population but are more common in children, especially teenagers.⁴⁹ The vast majority of individuals have one halo nevus, although at least 25% of patients have more than one halo nevus.⁵⁰ Depigmentation results from an immune response directed against the nevus. Microscopically, a band-like lymphohistiocytic infiltrate can be seen obliterating the

nevus cells. Interestingly, the peripheral white halo typically fails to show an inflammatory infiltrate, suggesting that the depigmentation is related to destruction of the melanocytes by a cytotoxic factor.⁵¹ The underlying mechanism by which the immune system targets the halo nevus is unknown. A subset of patients with halo nevi develop antibodies cytotoxic to melanoma cells. Most halo nevi regress over a period of months to years, leaving a depigmented macule, although in some cases the lighter area can repigment.

Halo nevi can be seen in patients with malignant melanoma, multiple dysplastic nevi, and vitiligo.^{52,53} In the vast majority of children, halo nevi occur as an isolated phenomenon; however, one halo nevus should prompt a complete skin examination, looking specifically for melanoma and vitiligo. A Wood's lamp examination can be very helpful to detect other halo nevi and vitiligo. A halo nevus is examined clinically, focusing on the central nevus. If the nevus is atypical appearing, it should be excised. If the nevus is clinically banal appearing, it is acceptable to follow the lesion clinically.

Atypical Melanocytic Nevus

Atypical melanocytic nevi are AMN with atypical clinical and microscopic features (Fig. 4). These unusual nevi were first described by Wallace Clark and have been referred to as Clark nevi, dysplastic nevi, and nevi with architectural disorder and cytological atypia. Although the concept of atypical nevus is relatively new, these lesions were observed over a century ago.⁵⁴ In 1820, William Norris suggested that malignant melanoma may be a hereditary disease associated with the formation of moles. He reported one family in which two members developed melanomas and other family members had many moles. In 1974, Munro described macroscopic and microscopic features of atypical nevi.⁵⁵ Several years

A

B

Figure 4 (A) A compound atypical melanocytic nevus. (B) The microscopic features of the nevus in A. The melanocytes are nested in at the dermal-epidermal junction and the superficial dermis. (Hematoxylin-eosin stain; original magnification $\times 40$.)

later, Clark et al suggested that atypical nevi be considered as a separate pathological entity associated with an increased risk of melanoma.⁵⁶ Like Norris, Clark reported two familial melanoma kindreds with multiple moles. The term B-K mole was coined, after the initials of the index families, to describe these unusual melanocytic nevi seen in association with malignant melanoma. In 1983, Lynch et al reported a similar kindred and introduced the term "familial atypical multiple mole melanoma syndrome."⁵⁷ Based on the atypical clinical, architectural, and cytological features, Greene and colleagues coined the term dysplastic nevus.⁵⁸ At present, clinical and histological features do not exist to define dysplastic nevi consistently, leading to the recommendation by the National Institutes of Health consensus conference in 1992 to employ the term nevus with architectural disorder rather than the term dysplastic nevus.⁵⁹

Atypical-appearing nevi occur with a prevalence of 7 to 18%, and microscopically atypical nevi occur with a prevalence of 10%.⁶⁰⁻⁶² In patients with malignant melanoma, the frequency of clinically atypical nevi is higher, ranging from 34 to 59%.⁶³⁻⁶⁶ Grossly, atypical nevi vary in appearance (size, border, symmetry, color) from benign-appearing AMN, but not to the significant degree seen in malignant melanoma. Multiple atypical nevi serve as a marker that an individual is at increased risk for melanoma.⁶⁷ In childhood, the appearance of atypical nevi before age 20 may signify increased melanoma risk (Fig. 5).

Although there is heterogeneity in the microscopic features of atypical nevi, Rivers et al identified architectural features consistently found in atypical nevi.⁶⁸ These features included the following: peripheral extension of the junctional melanocytic component beyond the central dermal nevus, elongation of the rete ridges, bridging of nests of melanocytes at the dermoepidermal junction, nests of melanocytes at the sides of rete ridges as well as at their bases, and concentric

Figure 5 A severely atypical nevus on the cheek of a 10-year-old boy.

eosinophilic fibrosis of the papillary dermis. Characteristics of the melanocytes themselves are not useful to identify atypical nevi.

Molecular studies have revealed genetic aberrations in atypical nevi that are intermediate between those found in benign nevi and melanoma, including abnormalities of DNA content,^{69,70} allelic losses, *p53* and *ras* gene mutations, and microsatellite instability.⁷¹

Similar to the surgical management of CMN, management of atypical melanocytic nevi varies considerably among providers.⁷² In children, changing atypical nevi should be sampled and examined microscopically. Surgical options include elliptical excision, punch excision, and shave excision. Irrespective of the chosen surgical technique, the entire nevus should be removed with thin margins, when clinically feasible. Flat melanocytic nevi may be easily removed by the shave technique, leaving small round scars. The shave technique is especially useful for children because it is quick and does not require sutures. Raised melanocytic nevi should undergo full-thickness excision to ensure that the base of the lesion is removed. For large melanocytic nevi or those in locations not conducive to complete excision, an incisional biopsy or multiple "scout" biopsies should be obtained.

At our center, we adhere to the following general guidelines. Severe atypical nevi are reexcised with 5-mm margins. Incompletely excised moderately atypical nevi are reexcised with narrow margins. Mildly atypical lesions are not reexcised. Before determining a course of action, several factors should be considered. First, benign nevi in children, especially infants, frequently show atypia microscopically. Nevi in acral sites (scalp, hands, and feet) and genitalia frequently show architectural and cytologic atypia. Second, recurrent nevi often are more atypical appearing microscopically than the original lesion. Thus, if the diagnosis of melanoma is in question, complete excision should be done to ensure that the nevus does not recur. Third, one must ensure that the pathologist or dermatopathologist examining the specimen is comfortable and experienced in the diagnosis of pigmented lesions in children. For consultants, such as plastic surgeons, who are frequently called upon to remove pigmented lesions without the benefit of seeing the original lesion or knowing the pathologist who rendered the diagnosis, it is prudent to have the original slides reexamined by a trusted colleague before removing the lesion.

Children and adults with so-called classic atypical mole syndrome with 100 or more melanocytic nevi, one or more melanocytic nevi 8 mm or larger in diameter, and one or more melanocytic nevi with atypical features⁷³ are at increased risk for development of malignant melanoma and, therefore, should be examined and observed regularly.^{66,74}

Spitz Nevus

Spitz nevi are benign melanocytic nevi that clinically and histologically may be difficult to distinguish from malignant melanoma. Before Dr. Sophie Spitz's description in 1948, these nevi were thought to represent malignant melanoma. Even Spitz herself did not consider these lesions as a group to be "unequivocally benign nevi of childhood, nor malignant melanomas of adults." In her original case series of 13 patients, one patient died from metastasis, indicating that clinical and histological differentiation from malignant melanoma can be difficult in many cases. Indeed, up to 40% of lesions diagnosed as melanoma may actually be Spitz nevi.

Although the true incidence of Spitz nevi is not known, Spitz nevi are more common in children than adults. The vast majority of Spitz nevi begin as small, well-circumscribed, dome-shaped pink papules that quickly grow to an average width of 8 mm (Fig. 6).⁷⁵ Spitz nevi are commonly pigmented; they can be verrucous, scaly, flat, pedunculated, and eroded. Approximately 40% of Spitz nevi occur in the head and neck region, although they commonly occur on the torso and extremities as well. Multiple Spitz nevi can occur in a segmental distribution, generalized, agminated (grouped), or in association with a nevus spilus.^{76,77}

To date, it remains very difficult to distinguish some Spitz nevi and Spitzoid melanoma from other types of malignant melanoma. To address this dilemma, Kapur et al examined markers of cellular proliferation and found that high levels of p21, low levels K_i-67 , and weak fatty acid synthetase expression are more commonly seen in Spitz nevi and Spitzoid melanoma than in malignant melanoma.⁷⁸ Gill and colleagues found that Spitzoid melanomas of childhood do not harbor activating hotspot mutations in *B-RAF*, *N-RAS*, or *H-RAS*, like malignant melanoma.⁷⁹ These results indicate that Spitzoid melanoma may represent a distinct type of melanoma.

Figure 6 A rapidly growing Spitz nevus on the finger of a child. This nevus was completely excised with skin grafting.

Biopsy techniques and management principles for Spitz nevi are similar to those described for atypical melanocytic nevi. Irrespective of the biopsy technique, it is essential that the entire lesion be removed with thin margins.⁸⁰ A biopsy of the entire lesion is essential for accurate microscopic diagnosis. In our center, we completely excise virtually all Spitz nevi, even if there is no microscopic atypia.

Recurrent Nevus

Partially removed melanocytic nevi often repigment and microscopically resemble malignant melanoma.⁸¹ Recurrent nevi exhibit a dermal scar, a greater number of melanophages, increased cytologic atypia, and asymmetry compared with the original nevi. However, these atypical architectural features are localized to the epidermis and dermis, immediately above the scar. Furthermore, recurrent nevi show decreased expression with HMB-45 and antityrosinase as the melanocytes mature within the dermis. This maturation pattern coupled with a low proliferative index (K_i-67) distinguishes recurrent nevi from melanoma.

Sohn et al compared original nevi and recurrent pigmented macules in previously Q-switched-mode laser-treated congenital nevi. These investigators found an increased number of melanocytes in the epidermis and reduced nevomelanocytic nests in the dermis.⁸² The expression of tumor necrosis factor α and E-cadherin was also evaluated and was down-regulated in the recurrent pigmented macules compared with the original nevi.⁸³

Despite these distinctive histological and molecular characteristic, some recurrent nevi are difficult to exclude from malignant melanoma. For this reason, markedly atypical nevi should be completely removed to prevent future recurrent nevi.

Malignant Melanoma

As a group, individuals younger than 20 years of age account for only 2% of all cases of malignant melanoma, and melanoma occurs with an incidence of 0.8 per million in the first decade of life.^{31,84} The incidence of melanoma is seven times greater in the second decade of life than in younger children, suggesting that prepubertal children differ from older children and adults (Fig. 7).

There are several differences between adults and children that deserve mention. First, childhood melanoma lesions often appear atypically with ulceration or lack of pigment (amelanotic), or both. In some cohorts, half of the childhood melanomas were amelanotic, resembling pyogenic granulomas.⁸⁵ Second, benign nevi in children commonly show atypical microscopic features that can mimic malignant melanoma. A recent study from Scotland found that over half of originally

Figure 7 A malignant melanoma, Breslow depth 0.67 mm, on the foot of an 8-year-old girl.

diagnosed melanomas were subsequently considered by an expert panel to be benign nevi.⁸⁶ Third, as previously mentioned, Spitz nevi can mimic malignant melanoma. For these reasons, atypical-appearing pigmented lesions, pyogenic granuloma-like lesions, and rapidly growing lesions should be biopsied and evaluated by a pathologist with a special interest in the skin or a dermatopathologist to rule out childhood malignant melanoma. Avoiding a misdiagnosis of melanoma is important because there are important medical, emotional, and financial consequences of this diagnosis.

To assist in melanoma diagnosis, some authors suggest utilizing sentinel lymph node (SLN) biopsy to assess atypical melanocytic lesions, including atypical Spitz nevi.⁸⁷ SLN biopsy has gained popularity to evaluate pigmented lesions in children; more than half of SLNs completed in children are for the evaluation of pigmented lesions.³¹ The use of SLN biopsy has increased despite no clinical or prognostic evidence to support it. Even in adults, SLN biopsy for malignant melanoma has not been definitively shown to improve overall survival. The possibility remains that children identified with positive lymph nodes may be overdiagnosed with melanoma, resulting in untoward humanitarian, ethical, and medicolegal effects. Until research confirms that SLN biopsy provides accurate diagnostic

and prognostic information, one should use it on a case-by-case basis after having a careful discussion with parents.

Blue Nevus

Blue nevi are blue-black or blue-gray melanocytic nevi occurring most commonly on the dorsal aspect of the hands and feet. Most commonly, these benign nevi arise during early childhood and adolescence, and they are thought to be due to melanocytes that have failed to migrate to the epidermis. This faulty melanocyte migration mechanism is also thought to explain the dermal melanocytosis seen in nevus of Ota, nevus of Ito, and Mongolian spots (Fig. 8).

At least three histological variants, referred to as cellular blue nevus, common blue nevus, and combined blue nevus, have been described. The common link between these variants is the presence of dermal pigmented spindle and dendritic melanocytes.⁸⁸ Common blue nevi appear as well-circumscribed papules, most commonly on the dorsal aspect of the hands. Cellular blue nevi typically appear as blue-gray plaques on the sacrococcygeal area, scalp, face, and feet. Blue nevi must be differentiated from primary and metastatic melanoma. Fortunately, melanoma is rare in children. Most blue nevi are clinically stable and do not require a skin

Figure 8 An infant with diffuse dermal melanocytosis.

Figure 9 A child with a congenital nevus spilus.

biopsy; however, if a blue nevus is changing or if the clinical diagnosis is in doubt, a skin biopsy should be obtained. Atypical-appearing blue nevi should be completely removed because malignant blue nevi have been reported.^{89,90}

Speckled Lentiginous Nevus (Nevus Spilus)

Nevus spilus, also known as speckled lentiginous nevus, arises as a flat to raised tan to brown nevus speckled with darker brown macules and papules. Nevus spilus may vary significantly in size from 1 cm to involve a large segment of the skin (Fig. 9). In childhood, as a nevus spilus evolves, new brown macules and papules arise within the underlying patch, making these lesions very difficult to follow for melanoma. There have been reports of melanoma arising within a nevus spilus. Spitz nevi and blue nevi have also been found to arise in association with nevus spilus.⁹¹ Speckled lentiginous nevi should be observed very closely for change. Serial photography and routine examinations should be done.

Other Melanocytic Nevi

Nevus of Ota, nevus fuscoceruleus ophthalmomaxillaris, is a collection of dermal melanocytes arising as bluish hyperpigmentation along the first or second branches of the trigeminal nerve.⁹² In the vast majority of patients, there is ipsilateral involvement of the sclera.^{93,94}

Nevus of Ito is a dermal melanocytic nevus affecting the shoulder area. Nevus of Ito often occurs in association with nevus of Ota in the same patient but is much less common, although the true incidence is unknown.

SUMMARY

Evaluating children with pigmented lesions is one of the most challenging aspects of pediatric dermatology. Pa-

rents and patients are often very fearful of the potential for malignancy. An understanding of the unique aspects of pigmented lesions in children is essential for successful outcomes.

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