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UNIVERSITÉ SIDI MOHAMED BEN ABDELLAH DE FES

EPIDEMIOLOGICAL PROFILE AND DERMOSCOPIC FEATURES OF MELANONYCHIA

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Professor MERNISSI Fatima Zohra

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ABREVIATIONS

LM : Longitudinal Melanonychia

NAM : Nail Apparatus Melanoma

NMN : Nail Matrix Nevi

SD : Standard Deviation

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INTRODUCTION

I. Overview

Melanonychia, defined as a black, brown, or gray pigmentation of the nail plate,[1] is a frequent clinical finding that encompasses a broad and heterogeneous spectrum of underlying causes.[2] Under physiological conditions, melanocytes within the nail matrix are usually quiescent and do not produce visible pigmentation. However, under various stimuli, these melanocytes can become activated, with or without proliferation, leading to pigment deposition within the nail plate.[2] This pigmentation can present in several patterns, with longitudinal melanonychia (LM)—characterized by a pigmented band extending from the proximal to the distal nail margin—being the most common.[1,3] Less frequently, the pigmentation may be transverse (transverse melanonychia) or involve the entire nail plate (total melanonychia).[1] Melanonychia may affect individuals of any age, involving one or multiple digits, in both the fingernails and toenails.[4]

Clinically, melanonychia is a diagnostic challenge, as it may arise from a wide array of both melanocytic and non-melanocytic etiologies. Melanocytic causes involve either activation or proliferation of nail matrix melanocytes.[1-3] Activation, which is generally benign, may be observed in cases of ethnic pigmentation, trauma, inflammatory diseases, or drug-induced changes.[2] Proliferation, on the other hand, may be benign—as seen in lentigines and nevi—or malignant, as in the case of nail apparatus melanoma (NAM).[1]

Importantly, NAM, a rare but aggressive form of melanoma, often presents as melanonychia. Approximately two-thirds of NAM cases are initially characterized by melanin-derived brown-to-black pigmentation of the nail, emphasizing the critical importance of distinguishing benign from malignant lesions at an early stage. [5]

Non-melanocytic causes of nail pigmentation also need to be carefully considered in the differential diagnosis. Brown-to-black discolorations can result from infections (bacterial or fungal), traumatic hematomas, deposition of exogenous substances, or other rare conditions.[1-3] In cases of non-melanocytic pigmentation, clinical examination complemented by ancillary investigations such as dermoscopy, mycological cultures, and histopathological analysis of nail clippings often leads to a definitive diagnosis.[2]

Despite these diagnostic tools, NAM is frequently misdiagnosed, leading to significant delays in treatment. Studies have reported that the diagnosis of NAM is often delayed by an average of two years. Such delays carry serious prognostic implications, with reported 5-year and 10-year survival rates of only 30% and 13%, respectively.[6] These statistics highlight the vital importance of an accurate and timely diagnosis in any case of unexplained melanonychia, particularly in adults presenting with a single affected digit without a clear benign cause.

Dermoscopy has emerged as an invaluable, non-invasive tool in the assessment of melanonychia. It enhances the visualization of the nail plate and matrix structures, allowing for better differentiation between benign and

malignant lesions.[4] Through dermoscopy, clinicians can assess features such as the such as color homogeneity, band width, border regularity, parallelism of lines, and pigment distribution, providing key insights that guide clinical decision-making and reduce unnecessary biopsies.[1,5] The dermoscopic evaluation of melanonychia relies on a structured approach that involves three critical steps: (1) determining whether the pigmentation is melanin-derived, (2) assessing whether the melanin deposition is due to activation or proliferation of melanocytes, and (3) if proliferation is suspected, discerning whether the process is benign or malignant.[1]

However, distinguishing between the various causes of melanonychia remains challenging. Many benign entities, including nevi, lentigines, ethnic pigmentation, drug-induced changes, and nail tumors such as onychopapilloma and onychomatricoma, can mimic melanoma dermoscopically. Similarly, non-melanocytic causes like onychomycosis or traumatic hemorrhages may display overlapping features. Therefore, a systematic and comparative analysis of dermoscopic characteristics across a wide range of melanonychia etiologies is necessary to refine diagnostic criteria and improve clinical practice.

In this context, the present thesis focuses on the dermoscopic evaluation of melanonychia, aiming to refine diagnostic criteria and enhance clinical practice. By identifying specific dermoscopic patterns associated with both benign and malignant causes, this work seeks to support earlier and more accurate diagnoses, ultimately improving patient outcomes and reducing unnecessary invasive procedures.

II. Basic Anatomy and Physiology of the Nail Apparatus[7,8]

The nail apparatus is a specialized structure of the skin composed of several distinct but interconnected components, each contributing to the integrity, growth, and function of the nail unit. It includes the nail plate, nail matrix, nail bed, hyponychium, and proximal nail fold (Fig. 1).[7]

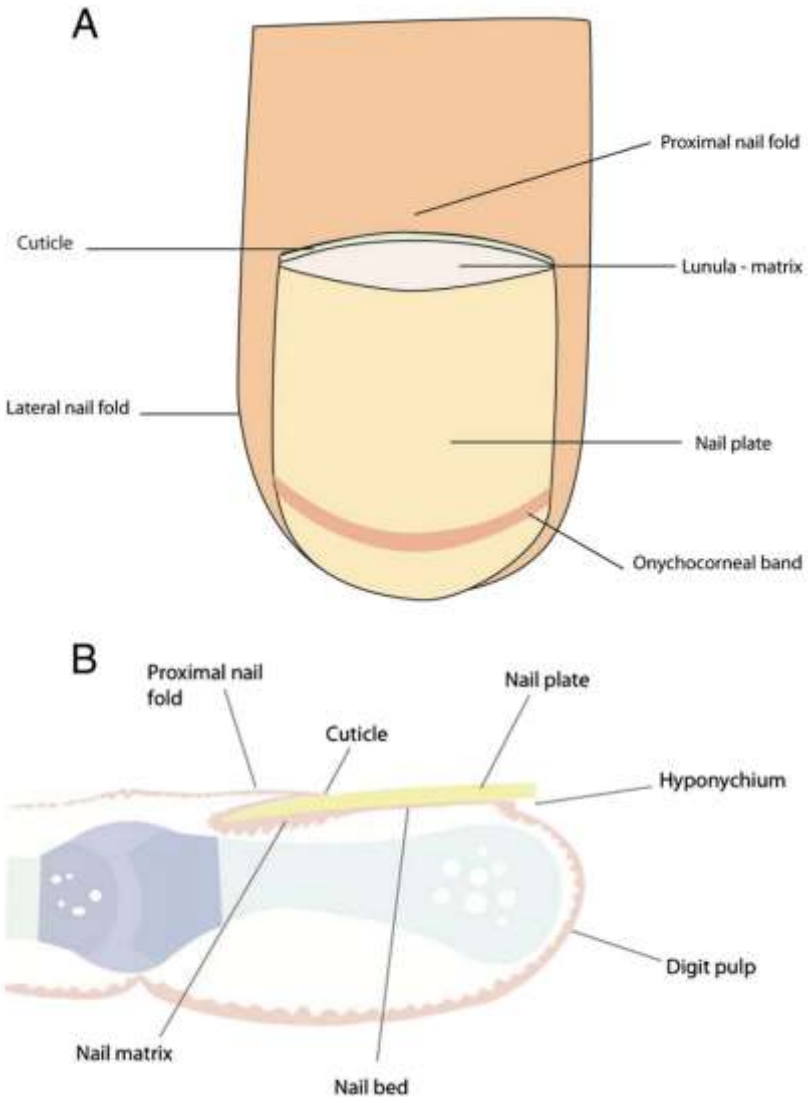

Figure 1 Plane (a) and sagittal (b) views of nail unit.[7]

The **nail plate** is the hard, keratinized structure visible on the dorsal aspect of the distal phalanges. It is primarily formed by the **nail matrix**, a germinative epithelial tissue located beneath the proximal nail fold and extending distally under the nail. The matrix is responsible for producing the majority of the nail plate through the proliferation and differentiation of keratinocytes. The **proximal matrix** contributes to the **dorsal portion** of the nail plate, while the **distal matrix** (also known as the ventral matrix) produces the **intermediate and ventral portions (Fig. 2)**. The relative contribution of each part of the matrix determines the final thickness and curvature of the nail plate.[7]

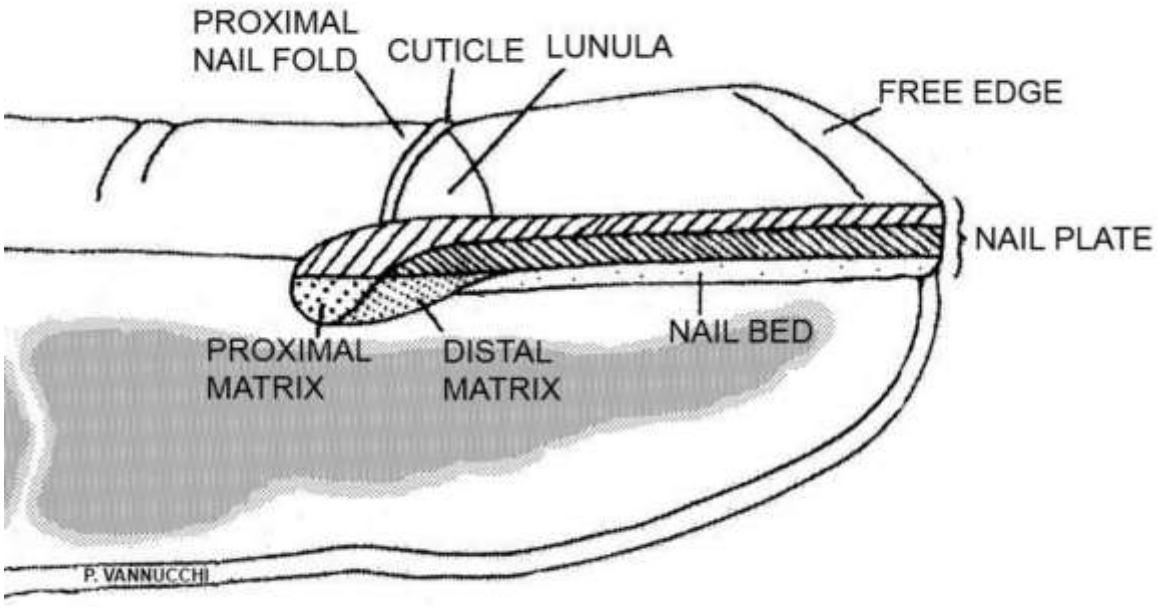

Figure 2 Formation of nail plate. The proximal portion of the nail matrix forms the upper third of the nail plate; the distal matrix forms the lower two thirds of the nail plate. The level of pigment (dorsal or ventral) within the band corresponds to the origin (proximal or distal) within the matrix.[9]

Beneath the nail plate lies the **nail bed**, a thin layer of epithelium that contributes minimally to the nail plate but plays an essential role in anchoring it to the underlying phalanx and providing vascular support.[10] Distally, the nail bed merges with the **hyponychium**, the area of thickened epidermis located under the free edge of the nail, which acts as a barrier against external contaminants. The **proximal nail fold** protects the emerging nail plate and hosts the cuticle (eponychium), a thin layer of keratin that seals the space between the nail plate and the fold.[8]

Among the specialized cells of the nail apparatus, **melanocytes** are of particular importance in the context of melanonychia. These pigment-producing cells are located primarily within the nail matrix, interspersed between the basal keratinocytes. The density of melanocytes in the matrix is estimated to be approximately 200 to 218 melanocytes per square millimeter, compared with approximately 1150 melanocytes per square millimeter in the skin.[11]

Notably, **nail matrix melanocytes differ from cutaneous melanocytes** in both structure and behavior. While skin melanocytes are highly active in melanin production, nail matrix melanocytes are typically quiescent under normal conditions, producing little to no visible melanin. Activation of these otherwise dormant cells, or an increase in their number through proliferation, underlies the development of melanonychia.[11,12]

III. Melanocyte Biology in the Nail Matrix

Melanocytes are dendritic, pigment-producing cells derived from the neural crest, playing a key role in melanin synthesis in the skin, hair, and nails. In the nail unit, melanocytes are primarily located within the nail matrix, where they are interspersed among basal keratinocytes and contribute to pigmentation of the nail plate under specific physiological or pathological conditions.[7,8,12]

The density and distribution of melanocytes vary throughout the nail apparatus. The nail matrix contains approximately 200 melanocytes per square millimeter, while the nail bed has a significantly lower density—around 50 melanocytes per square millimeter. However, despite this presence, melanocytes in both regions are typically quiescent in individuals with light skin phototypes. However, baseline melanocyte activity is more common in individuals with darker skin, in whom nail pigmentation may be physiological.[11,13]

There is a notable difference in melanogenic activity between melanocytes of the proximal and distal nail matrix. Although the melanocyte count is similar in both regions, those located in the distal matrix exhibit significantly higher functional activity. Approximately 50% of melanocytes in the distal matrix are active, as demonstrated by L-DOPA positivity, which reflects ongoing melanin synthesis.[2,14] This activity contributes to physiological or pathological pigmentation or melanonychia through melanocytic activation, also referred to as hypermelanosis. In contrast,

melanocytes in the proximal matrix are typically functionally inactive under normal circumstances and do not contribute to nail pigmentation unless stimulated by pathological processes such as benign or malignant proliferation.[2,11] Importantly, distinguishing whether melanonychia originates from the proximal or distal matrix has clinical relevance, as pigmentation arising from the proximal matrix—particularly if irregular or involving the cuticle—raises greater concern for malignant processes such as subungual melanoma.[2] Recognition of the site of origin aids in appropriate risk stratification and guides diagnostic decisions, such as the need for biopsy. Activation involves increased melanin production without an increase in melanocyte number, whereas proliferation refers to an actual increase in melanocyte count, as seen in benign conditions such as nevi and lentigines, or in malignancies such as subungual melanoma.[2]

The pattern of melanin deposition within the nail plate offers important diagnostic clues. Pigmentation arising from the distal matrix tends to localize to the lower portion of the nail plate, while pigment derived from the proximal matrix is deposited more superficially (Fig. 3).[2] When the entire thickness of the nail plate is involved, it may reflect more diffuse melanocyte activity or proliferation. These differences can sometimes be evaluated using dermoscopy of the nail plate's surface and free edge, aiding in the topographical localization of melanocytic activity and supporting differential diagnosis. In this context, knowing the precise site and technique of biopsy is essential, as sampling the appropriate matrix region—proximal or distal—

ensures accurate histopathologic correlation with clinical and dermoscopic findings.[8,15]

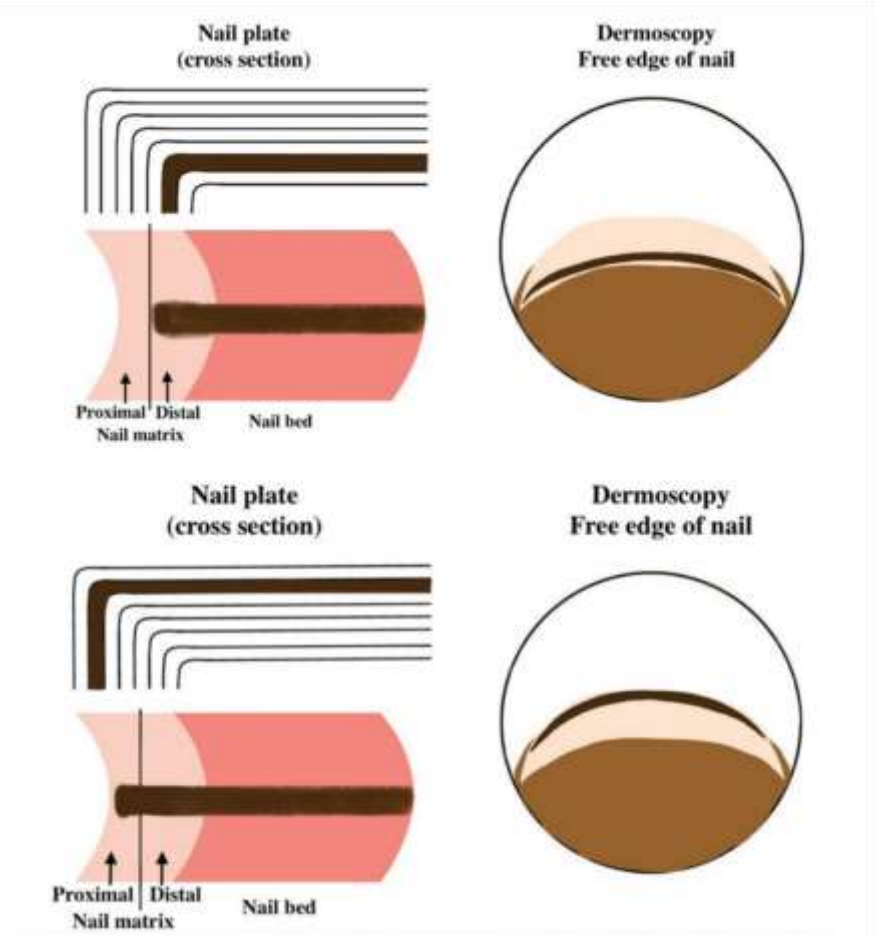

Figure 3. This schematic illustrates how the location of melanocytic activation within the nail matrix influences the pattern of pigmentation observed in longitudinal melanonychia.[16]

Understanding the biology and behavior of nail matrix melanocytes is crucial for distinguishing benign melanonychia from potentially life-threatening conditions, thus guiding appropriate diagnostic and therapeutic strategies.

IV. Definition and Classification of Melanonychia

Melanonychia is a clinical term describing brown or black pigmentation of the nail plate, resulting from melanin produced by the melanocytes located primarily in the nail matrix. The word itself is derived from the Greek "melas" (black) and "onyx" (nail),[17] reflecting the characteristic discoloration observed in affected individuals. A thorough understanding of its classifications is essential, as it provides a framework for clinical assessment and diagnostic reasoning. Melanonychia can be classified according to clinical appearance, extent of nail involvement, and etiopathogenic mechanisms.

1. Clinical Morphology:

a. Longitudinal melanonychia:

The most common form presents as a pigmented band running parallel to the longitudinal axis of the nail, from the proximal nail fold or matrix to the distal edge (Fig. 4). It varies in width, color intensity, and borders. Longitudinal bands may be solitary or multiple and can be seen in both benign and malignant conditions.[3,17]

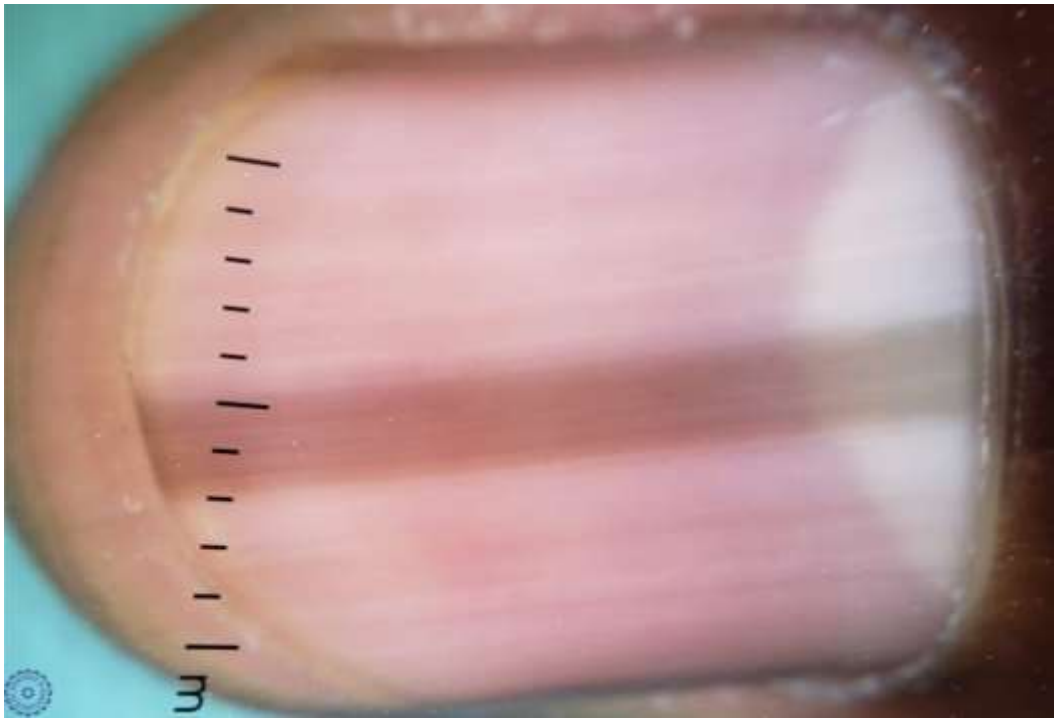

Figure 4 Longitudinal melanonychia

b. Transverse melanonychia:

Rare, presenting as a band running perpendicular to the nail's long axis (Fig. 5). It is most often associated with systemic drug exposure or trauma.[17,18]

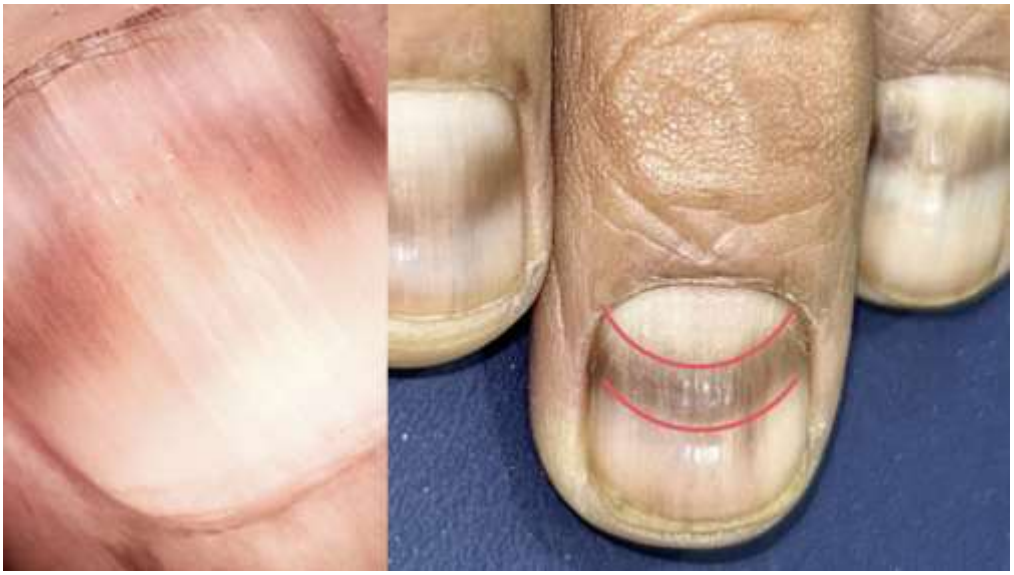

Figure 5 Transverse melanonychia affecting all fingernails and toenails in a patient undergoing treatment with dasatinib. Pigmentation appears as well-demarcated, homogenous gray bands aligned transversely across the nail plates. Onychoscopic examination reveals multiple fine longitudinal gray lines within homogenous gray transverse bands of chromonychia.[19]

c. Total melanonychia:

In this presentation, the entire nail plate is uniformly pigmented (Fig. 6). It may result from extensive melanocytic activation (e.g., drug-induced pigmentation, ethnic pigmentation) or diffuse melanocytic proliferation.[2,17]

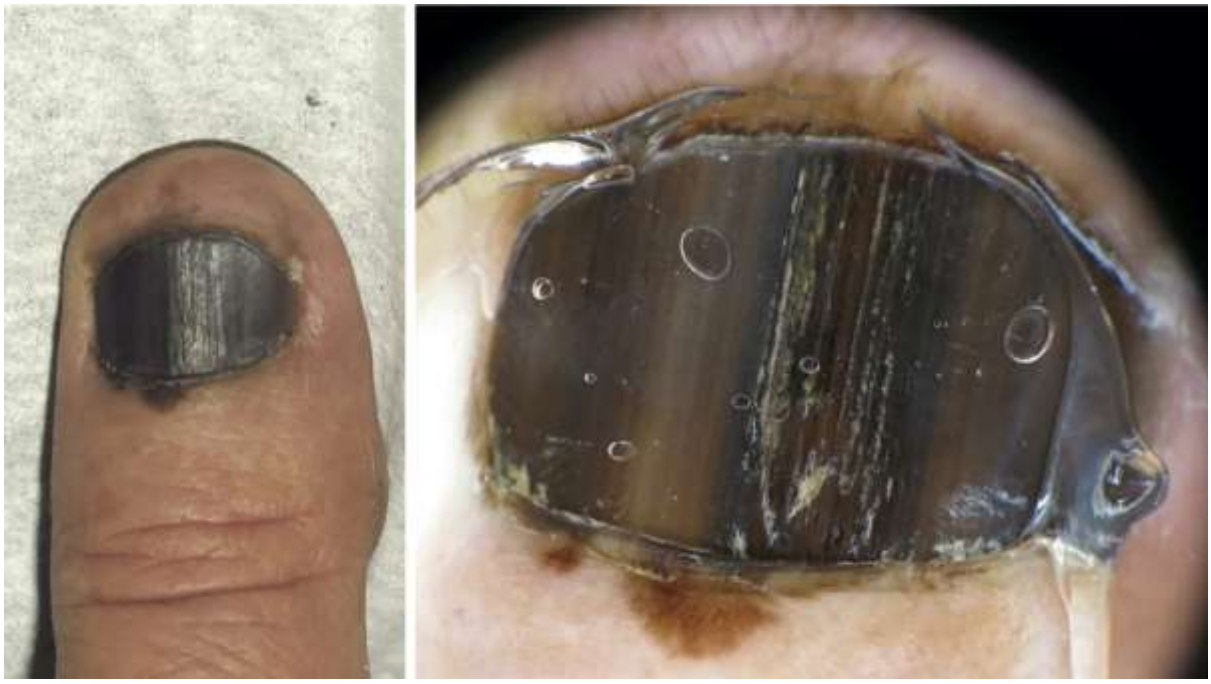

Figure 6 Total Melanonychia[4]

2. Extent of Nail Involvement

a. Monodactylic melanonychia:

Pigmentation limited to a single nail. This raises suspicion for a localized cause such as a nevus, lentigo, trauma, or melanoma.[17]

b. Polydactylic melanonychia:

Involvement of multiple nails, often seen in systemic or physiological conditions such as ethnic pigmentation, drug reactions, endocrinopathies, or syndromic associations.[17]

3. Etiopathogenic Classification

Melanonychia can further be classified based on the origin and behavior of melanocytes:

a. Melanocytic melanonychia:

Caused by melanin deposition from melanocytes, which may occur through:

- **Melanocytic activation** (hypermelanosis): Increased melanin production by existing melanocytes without cellular proliferation. This process typically occurs in the distal matrix, is usually benign, and may be triggered by factors such as trauma, medications, pregnancy, inflammatory dermatoses, or systemic diseases.[2]
- **Melanocytic proliferation**: An actual increase in melanocyte number, often arising in the proximal matrix. This proliferation may be **benign** (e.g., lentigo, melanocytic nevus) or **malignant** (e.g., subungual melanoma). [2]

Distinguishing between activation and proliferation is particularly important in cases of monodactylic longitudinal melanonychia, where malignancy must be ruled out.[2,3]

b. Non-melanocytic melanonychia:

Pigmentation not due to melanin but to other substances such as:

- **Exogenous pigments** (e.g., dyes, chemicals, tobacco, henna)
- **Blood pigments** (e.g., subungual hematoma)
- **Fungal or bacterial infections** (especially with pigmented organisms)

A clear distinction between these categories is fundamental for the diagnostic approach and helps prioritize further work-up (e.g., dermoscopy, biopsy) depending on the suspected cause.

V. Dermoscopic patterns in Melanonychia

Dermoscopy of the nail unit, or onychoscopy, is a non-invasive technique that enhances the visualization of subsurface features within the nail plate and periungual tissues. It plays an essential role in the evaluation of melanonychia, particularly longitudinal melanonychia, by enabling detailed assessment of pigment characteristics such as color, distribution, and pattern. These features may aid in distinguishing between benign lesions, such as melanocytic nevi, and malignant conditions, notably subungual melanoma.[20,21]

The dermoscopic examination of the nail should ideally be performed using both polarized and non-polarized light, with attention given to the nail plate surface, the free edge, and periungual skin.[20] The analysis should always be interpreted in conjunction with clinical findings, as certain patterns may overlap between benign and malignant entities.

1. Technical Considerations

The technique of dermoscopy for nail examination requires proper preparation. It is recommended to avoid recent trauma or cosmetic interference (e.g., nail polish), which may alter the pigmentation, and the nail plate cleaned with acetone or alcohol to remove debris.[20] An interface medium should be used to reduce reflection and enhance image quality; options include antiseptic gels (e.g., alcohol), water-based gels (e.g., ultrasound gel), or oils (e.g., mineral oil).[21] The digit should rest lightly on a hard, non-reflective surface, with minimal pressure. Examination of the free edge of the

nail is particularly informative, as it allows assessment of the vertical location of pigment within the nail plate, indirectly reflecting the origin of melanogenesis within the matrix.[20] While dry dermoscopy is particularly useful for evaluating surface features of the nail plate, immersion—especially with ultrasound gel—is recommended for pigmented lesions, as it enhances visualization through the translucent nail plate, despite the inconvenience of gel slippage on the curved surface.[1]

2. Principal Dermoscopic Patterns

a. Regular Longitudinal Pattern

The most commonly observed pattern is that of parallel longitudinal lines, which may vary in regularity, color, thickness, and spacing. In benign conditions—such as ethnic pigmentation, melanocytic nevi, or drug-induced activation—the lines are typically thin, uniform in width and color, regularly spaced, and oriented along the longitudinal axis of the nail (Fig. 7).[17]

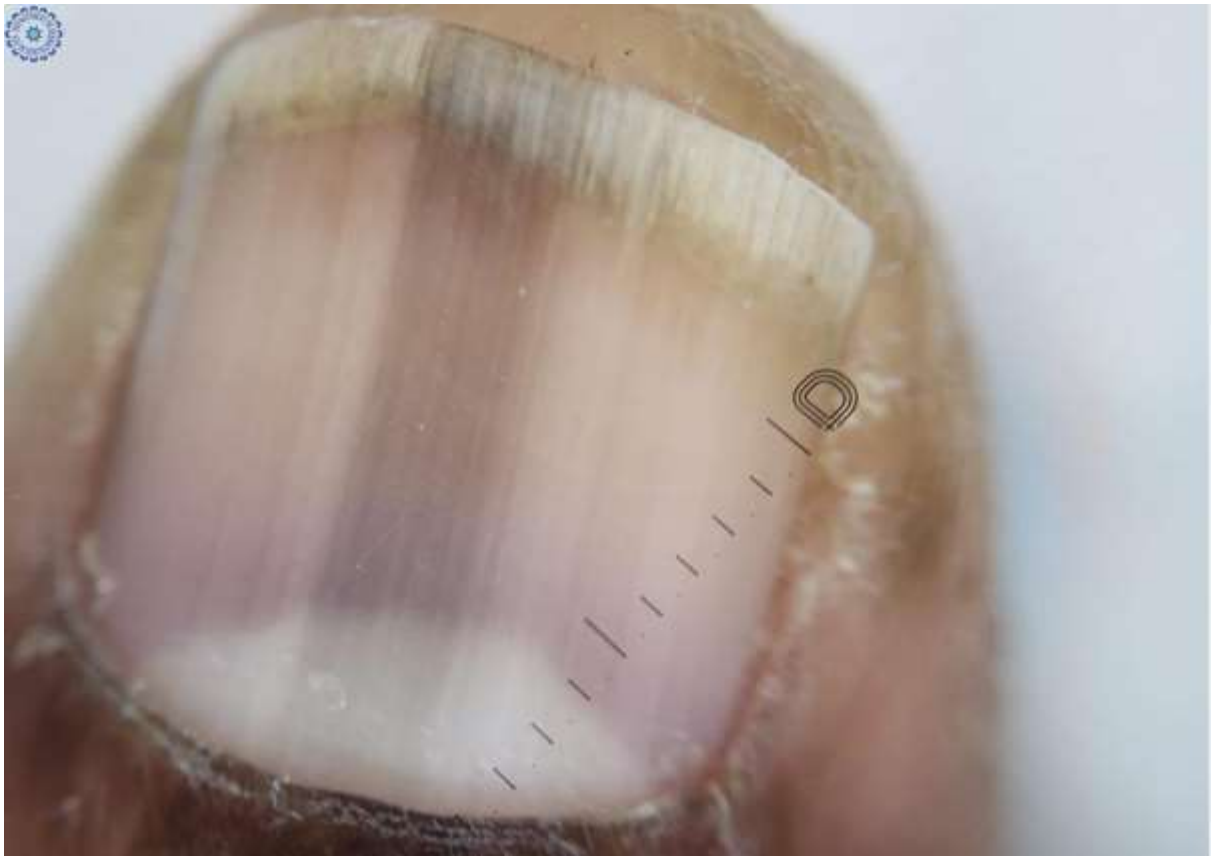

Figure 7 Longitudinal melanonychia showing parallel lines that are uniform in width and color, with regular spacing — features suggestive of a benign pattern.

b. Irregular Longitudinal Pattern

In contrast, subungual melanoma often presents with irregular lines showing asymmetry in thickness, spacing, and color, with variegated hues including brown, black, gray, and occasionally red (Fig. 8).[1,5,22]

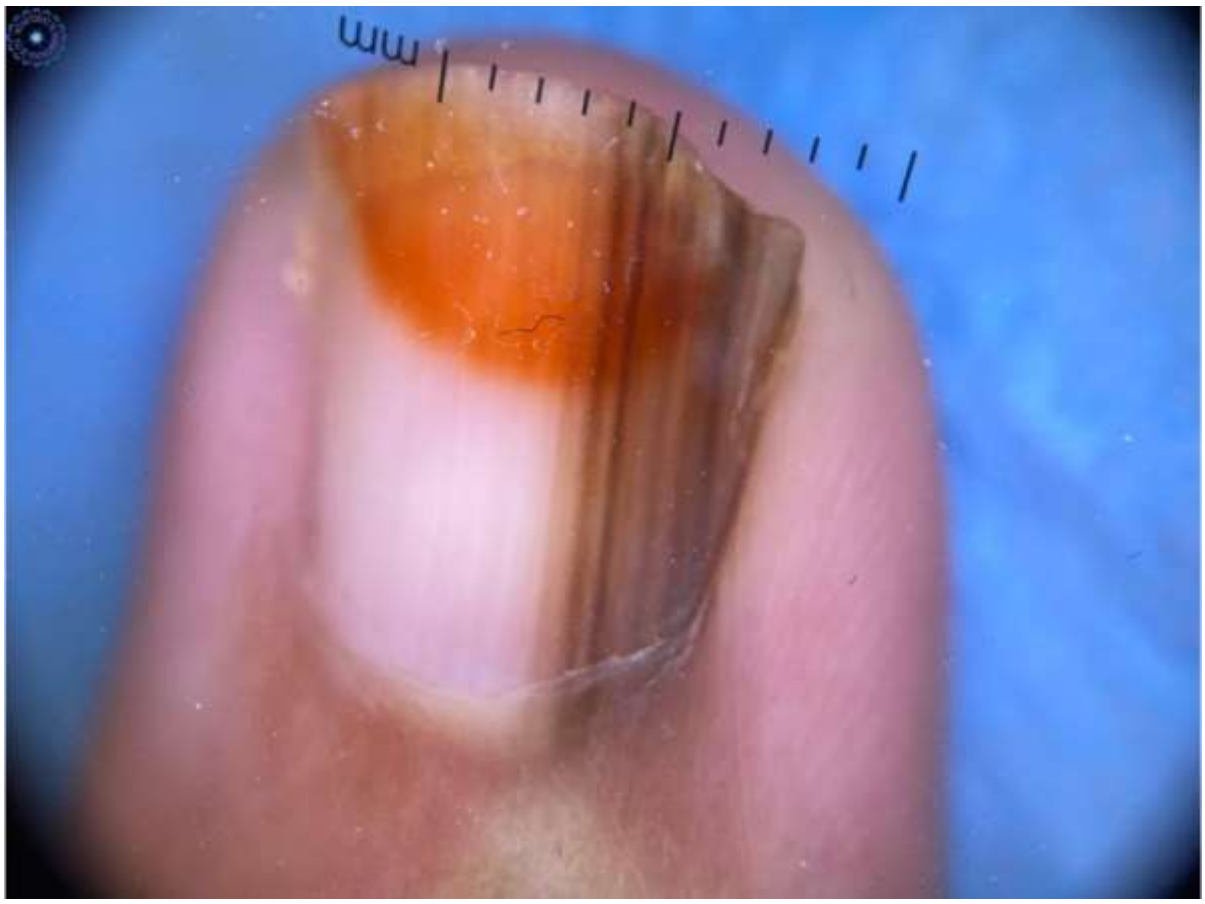

Figure 8 Longitudinal melanonychia displaying irregular lines with asymmetry in thickness, spacing, and color — features raising concern for a possible malignant process. (melanoma)

c. Homogeneous Brown Pattern

Homogeneous pigmentation—light brown, dark brown, or gray—without visible linear structures, may be seen in diffuse melanocytic activation, particularly in drug-induced or post-inflammatory pigmentation.[2] The color of the pigmentation is a key diagnostic clue, as it reflects both the depth of melanin deposition within the nail plate and the intensity of melanin production. Typically, brown to black hues are associated with melanocytic proliferations involving the proximal matrix, where melanin is deposited in the superficial layers of the nail plate, resulting in a darker appearance (Fig. 9). Melanocytic nevi and melanoma frequently present with these deeper tones;

however, melanoma often shows additional heterogeneity in color and structure, which may suggest malignancy.[5,6]

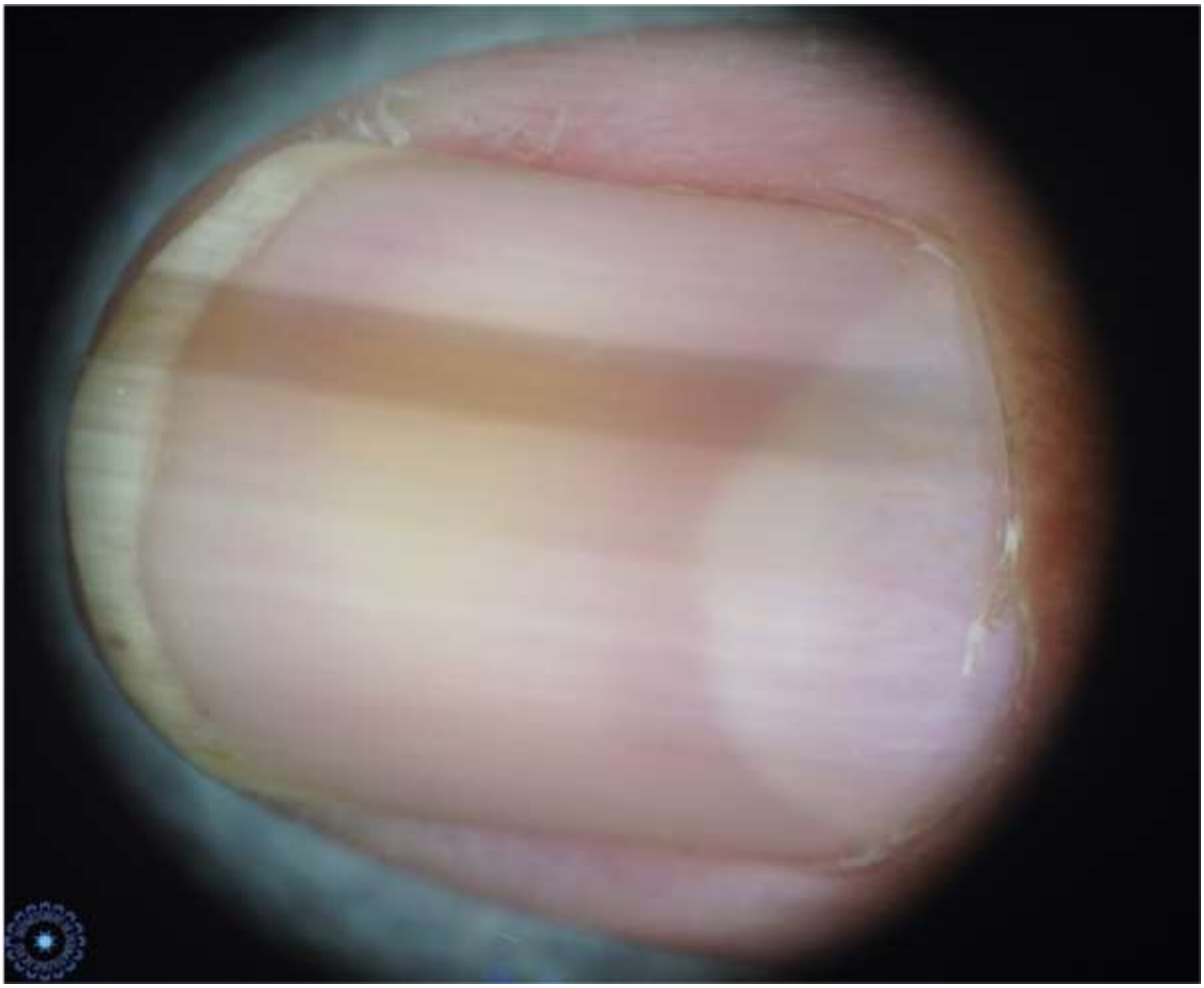

Figure 9 Longitudinal melanonychia presenting as a homogeneous-brown band, consistent with a benign pigmentation pattern.

d. Homogeneous Gray Pattern

In contrast, grayish tones are more commonly seen in melanocytic activation, especially in drug-induced or post-inflammatory contexts.[15] In these cases, melanin production is generally lower, and the pigment is either diffusely distributed or deposited in deeper layers of the nail plate, resulting in a lighter, grayish appearance. Interestingly, lentigo—despite being a

melanocytic proliferation of the proximal matrix—may also display a pseudo-gray pattern, consisting of fine gray lines or a grayish background (Fig. 10).[4,15] This might be attributed to the limited quantity of melanin and its superficial localization, which reduces the optical density of the pigmentation.

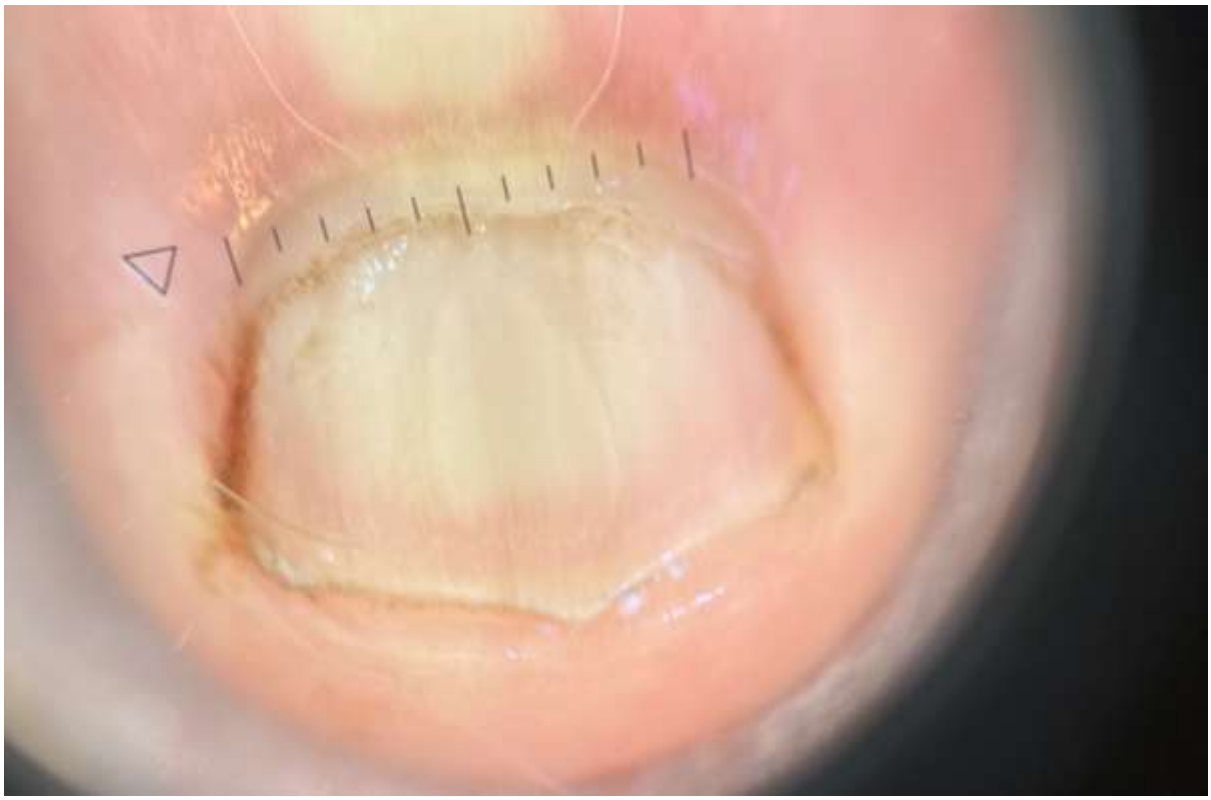

Figure 10 Longitudinal melanonychia presenting as a homogeneous gray band, consistent with a benign pigmentation pattern.

e. Pigmented Granules

Pigmented granules are a dermoscopic feature occasionally observed in melanonychia, characterized by small, dot-like or granular pigmented deposits within the nail plate (Fig. 11). These granules may be brown, black, or gray and are often irregular in shape and distribution. Their presence has been associated with melanocytic proliferation, particularly in subungual melanoma, where they may reflect focal melanin clumps or disrupted melanin

dispersion due to atypical melanocyte activity.[2,23] However, pigmented granules are not specific to malignancy and may also be seen in benign lesions such as melanocytic nevi, lentigines, or even ethnic melanonychia.[23] Their interpretation should always be made in conjunction with other dermoscopic features—including the pattern, color, and regularity of longitudinal lines—and within the broader clinical context.[2,23]

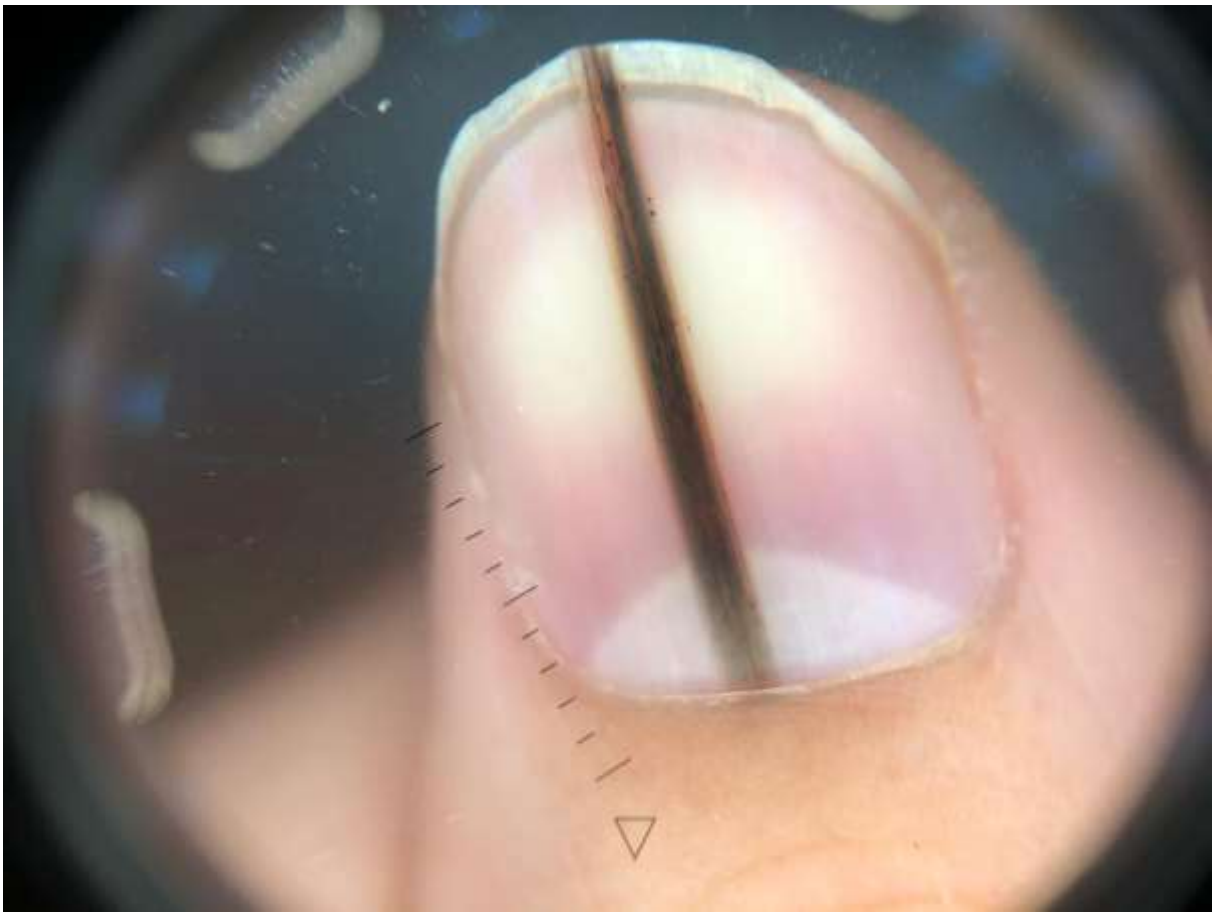

*Figure 11 Longitudinal melanonychia showing **irregular longitudinal lines** accompanied by **dispersed globules with variable shapes and asymmetric distribution**, suggestive of a concerning melanocytic lesion.*

f. Free Edge Dermoscopy

Further diagnostic insight can be gained through examination of the free edge of the nail plate, which allows for topographic localization (Fig. 12).

Pigment seen in the upper portion of the nail plate generally indicates involvement of the proximal matrix, whereas pigmentation in the lower portion suggests origin in the distal matrix.[2,17] When melanin spans the full thickness of the nail plate, it may reflect diffuse melanogenesis, seen in both benign and malignant conditions.[2,5] Moreover, free-edge examination can reveal nail plate deformities or localized thickening, which may suggest non-melanocytic tumors such as onychopapilloma, onychomatrichoma, or Bowen disease.[1,2,4]

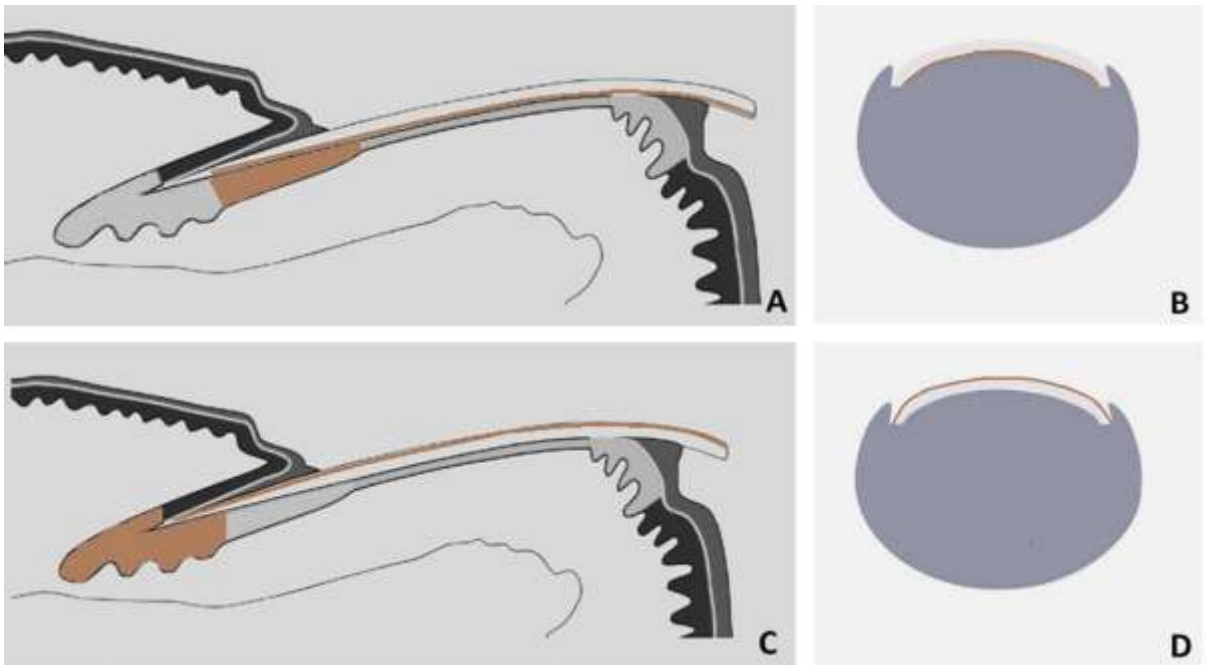

Figure 12 Schematic drawing of matrix pigment in correlation to depth of nail plate pigmentation. (A and B) Melanonychia with origin in distal nail matrix will be found in lower part of free nail edge. (C and D) Melanonychia with origin in proximal nail matrix will be found in upper part of free nail edge.[2]

g. Hutchinson's and Pseudo-Hutchinson's Signs

Hutchinson's sign (Fig. 13)— the extension of pigmentation onto the proximal nail fold or surrounding periungual skin—is a critical dermoscopic clue suggestive of nail melanoma.[3,22,24] However, it is not pathognomonic and may also be seen in benign conditions such as nail matrix nevi, lentigines,

ethnic melanonychia, and Laugier-Hunziker syndrome, with an estimated frequency of up to 33%.[25-27] This sign should be distinguished from pseudo-Hutchinson's sign (Fig. 14), where the pigmentation of the matrix is visible through the transparent cuticle, particularly in darker phototypes or in children with benign lesions.[1]

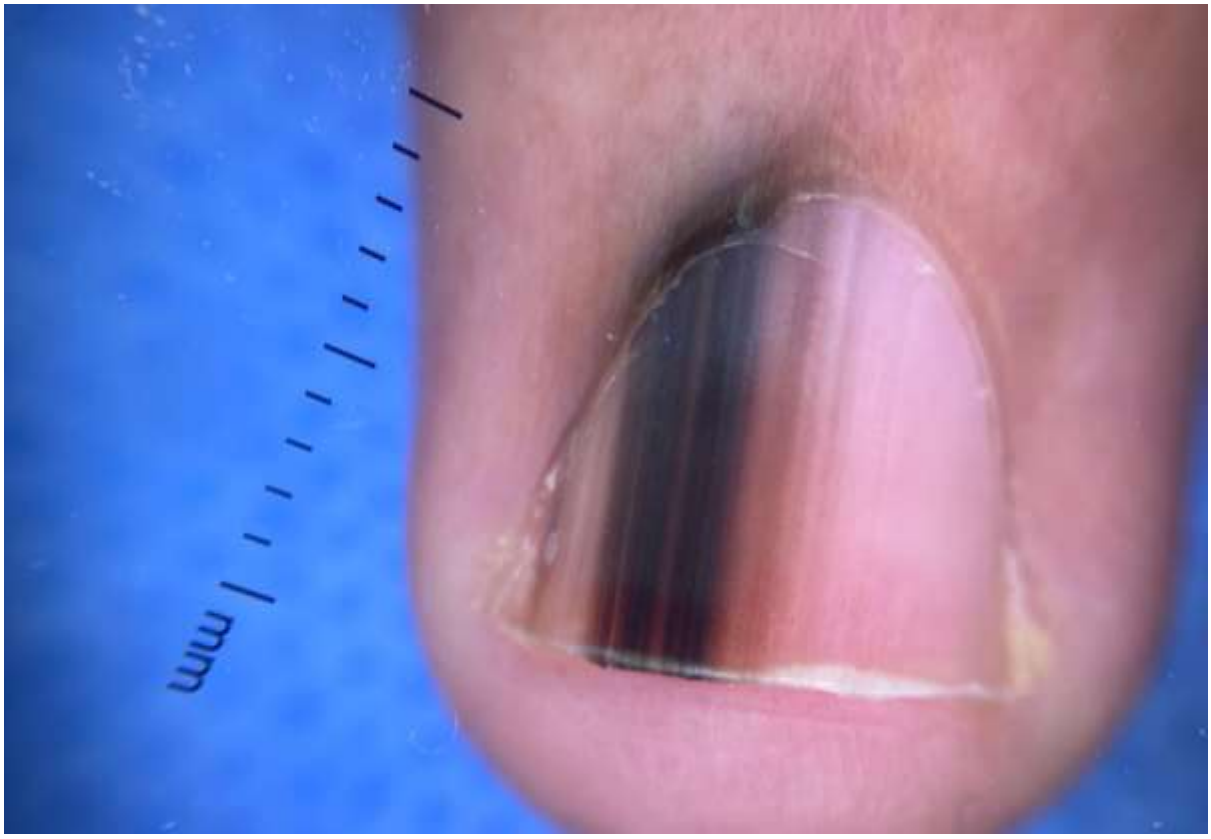

Figure 13 Hutchinson's Sign

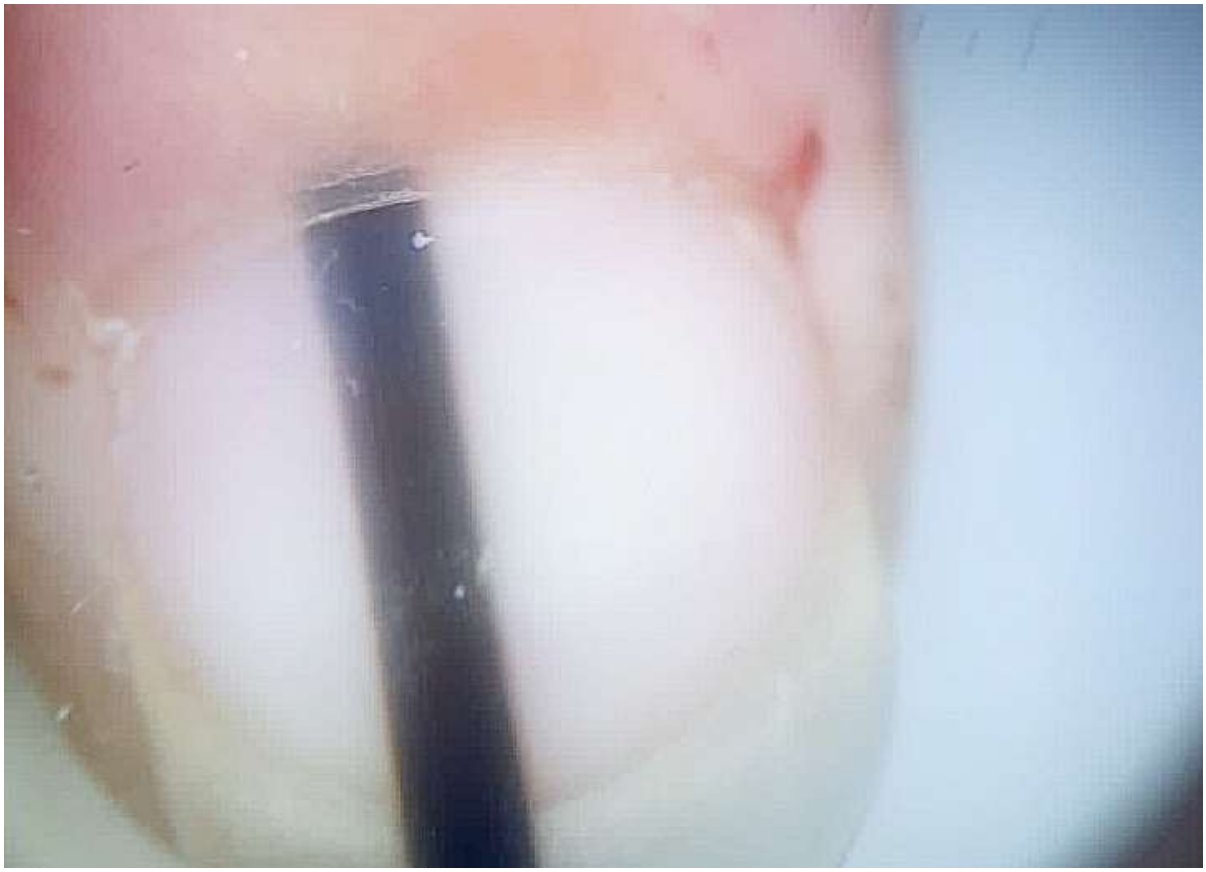

Figure 14 Pseudo-Hutchinson's sign

h. Clinical Context and Diagnostic Clues

When evaluating melanonychia, dermoscopic features must always be interpreted in clinical context. Findings suggestive of a benign process include multiple affected nails, childhood onset, stability over time, homogeneous color, and regular line patterns. Features raising concern for melanoma include a single affected digit (especially the thumb or hallux), adult onset, progressive widening or darkening of the band, irregular or multicolored pigmentation, and true Hutchinson's sign—all of which may warrant biopsy.[17]

i. Limitations of Dermoscopy

Despite its diagnostic value, dermoscopy has limitations. It requires expertise and experience, and early melanomas may occasionally exhibit benign-appearing features. Conversely, certain benign lesions—such as nail matrix nevi in children or ethnic melanonychia in individuals with darker phototypes—can mimic malignancy. As such, dermoscopy should be considered a complementary tool; when clinical or dermoscopic suspicion persists, histopathological examination remains essential for definitive diagnosis.

VI. Etiologies of Melanonychia

1. Melanocytic Activation

This mechanism involves increased melanin production by existing melanocytes in the nail matrix, without an increase in their number. It is often **benign** and may be physiological or reactive.[2]

On histology, no increase in melanocyte number is observed; the melanonychia is attributed to functional stimulation of mature melanocytes, with pigment transfer to keratinocytes. Basal pigmentation varies in intensity. When subtle, Fontana staining may be necessary to visualize melanocyte dendrites. In other cases, the pigmentation is more pronounced and may extend throughout the epithelium. The presence of marked pigmentation

despite a low melanocyte count is considered a reassuring feature suggestive of benignity.[28]

Melanocytes are difficult to identify on routine stains; immunohistochemistry using HMB-45 and Melan-A typically reveals 4-10 melanocytes per millimeter (mean: 7.7) in basal and suprabasal layers, without evidence of proliferation (Fig. 15).[29]

The pathologist may diagnose melanocytic activation, although the underlying cause often remains undetermined.[3,29]

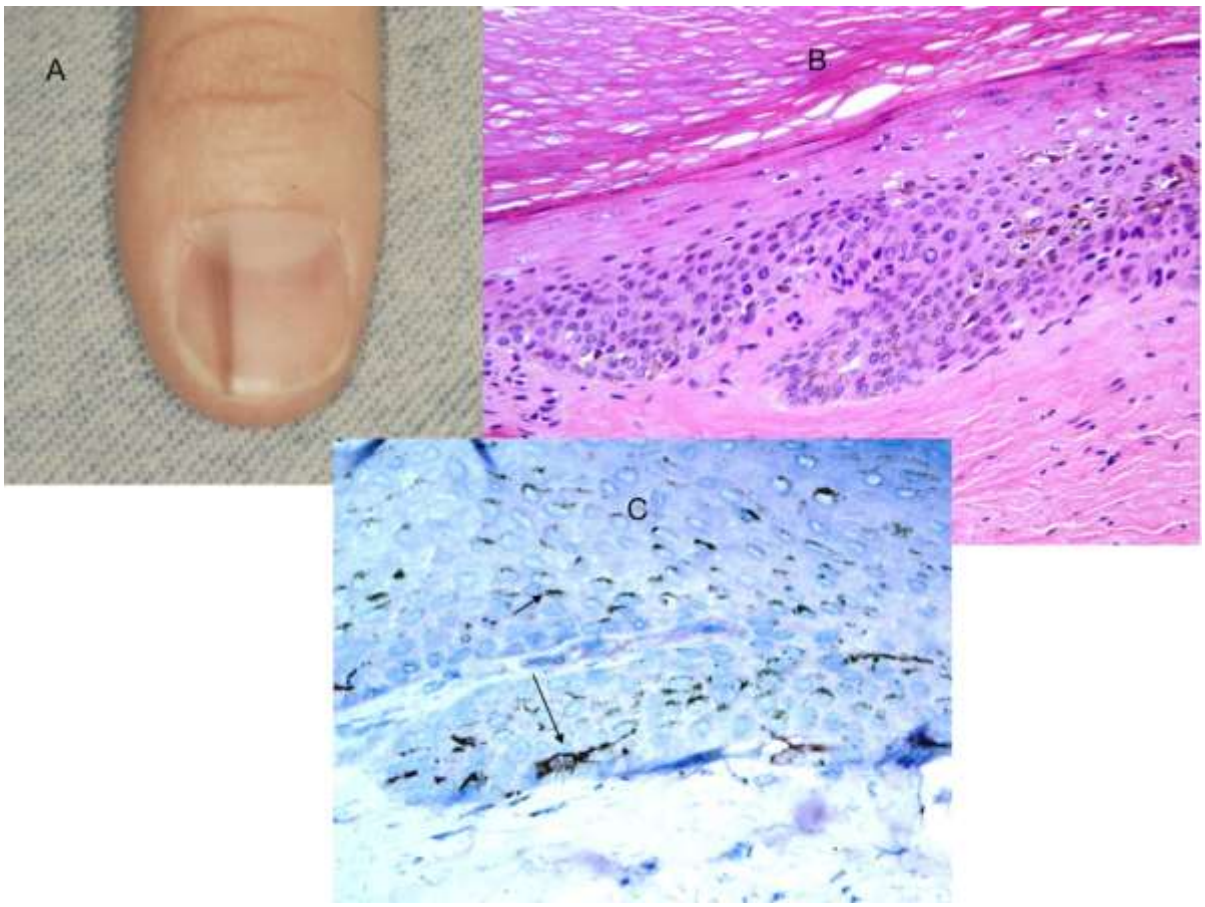

Figure 15 Melanocytic activation. (A) Clinical, gray-tan narrow pigmented band (Courtesy of Paula Vogel, MD); (B) Increased melanin in matrical epithelium, without an obvious increase in melanocyte density (hematoxylin and eosin, 200x); and (C) Melan-A with Giemsa counterstain, with melanocytes staining brown (long arrow), and melanin within keratinocytes staining a greenish hue (short arrow) (400x).[11]

a. Ethnic melanonychia

Also known as racial melanonychia, is a common benign cause of longitudinal melanonychia resulting from melanocytic activation in individuals with darker skin phototypes (Fitzpatrick IV to VI), including those of African, Asian, Hispanic, or Middle Eastern descent.[6,17] It manifests as one or more brown to black longitudinal bands, most often affecting the fingernails, particularly the thumb, index, and middle fingers (Fig. 16). The bands are usually symmetric, stable over time, and may involve multiple nails.[6] While rare in children, it becomes increasingly prevalent and prominent with age, affecting up to 77% of dark-skinned adults by the age of 20 and in 95% by the age of 50.[3]

Figure 16 Ethnic melanonychia in a 25-year-old Sub-Saharan African patient, showing multiple longitudinal pigmented bands on the fingernails, varying in both color and width.

Onychoscopy shows grayish, homogeneous bands with regular lines—features consistent with benign melanocytic activation. Due to the Tyndall effect, these bands may appear lighter or grayer under dermoscopy than to the naked eye, which may suggest a darker hue (Fig. 17).[2,30] Free edge examination often confirms pigment confined to the lower portion of the nail plate.

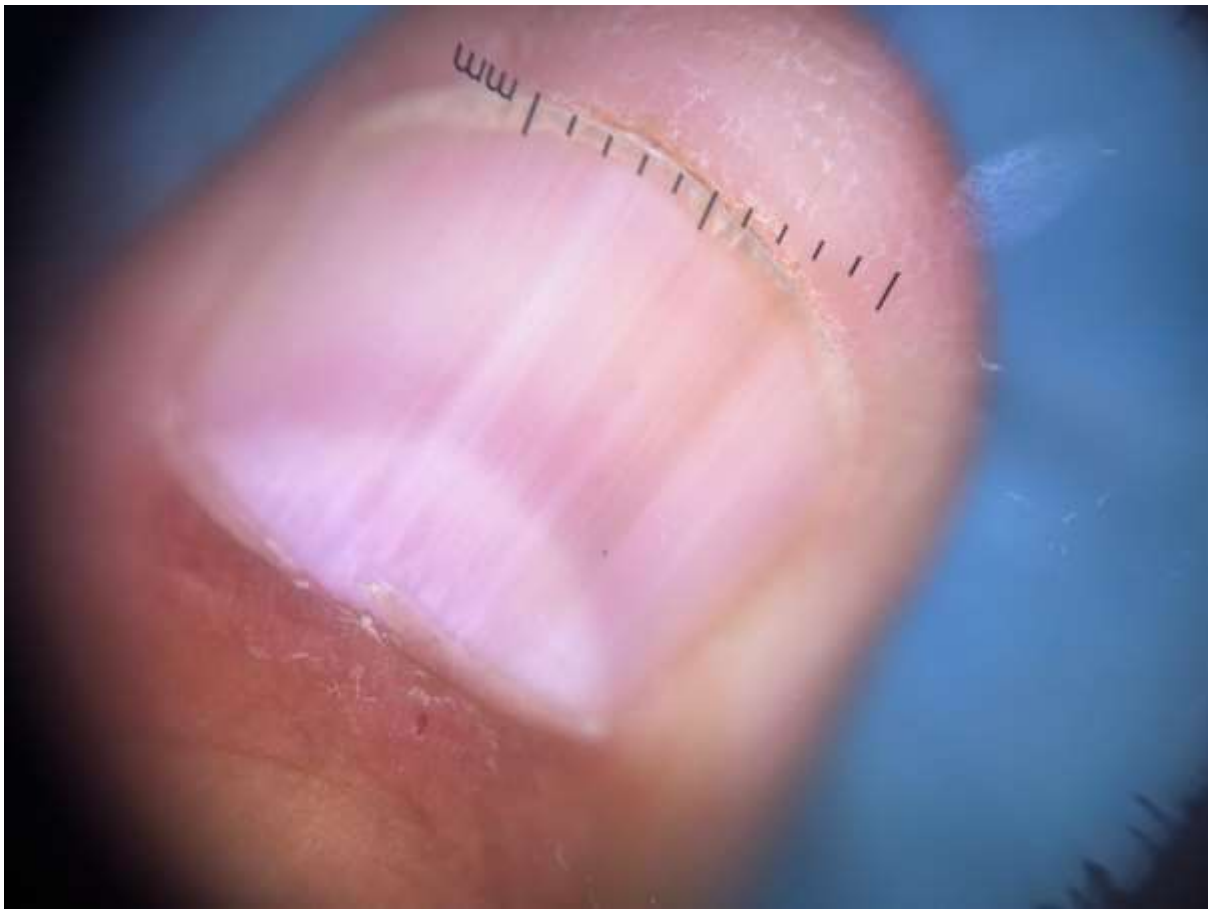

Figure 17 Dermoscopy of ethnic melanonychia showing regular, thin, light brown and gray longitudinal lines on a light background.

Histological confirmation is rarely necessary in typical cases.[30] However, unfamiliarity with dermoscopic patterns in dark phototypes has historically led to unnecessary biopsies. When clinical and dermoscopic features align with benign racial melanonychia, conservative management without biopsy is

preferred, especially considering the risk of permanent nail dystrophy post-procedure.[30]

b. Pregnancy-related melanonychia

This type of melanonychia is attributed to hormonal stimulation of melanocytes. It tends to be benign, transient, and limited to a few nails. Dermoscopic patterns resemble physiological pigmentation, typically uniform and symmetrical.[1–3]

c. Drug-induced melanonychia

Melanonychia may result from a wide range of medications, including chemotherapeutic agents (e.g., cyclophosphamide, doxorubicin), antiretrovirals (e.g., zidovudine), antibiotics (e.g., minocycline) and psychotropic drugs. The pigmentation may be longitudinal, transverse, or diffuse, depending on the nature of melanocyte involvement and the pattern of drug exposure (Fig. 18).[3,17,19]

The precise pathophysiology remains incompletely understood but appears multifactorial. Potential mechanisms include direct cytotoxic effects on the nail matrix, which alter melanocyte activity and disrupt normal pigmentation, and pharmacologic stimulation of melanocytes, possibly through modulation of intracellular signaling pathways or receptor-mediated activation. In some cases, drug accumulation within the nail plate itself may contribute to pigmentation, particularly in cases of diffuse melanonychia.[11,19]

When melanocyte stimulation occurs across the entire matrix, it can lead to diffuse or transverse pigmentation, depending on whether the stimulation is sustained or episodic.[18,19,31] In contrast, focal melanocytic activation—more localized within the matrix—typically results in longitudinal melanonychia.[17] An interesting clinical observation is that intermittent drug administration may produce an alternating pattern of pigmented and non-pigmented transverse bands, corresponding to treatment cycles.[32]

On dermoscopy, drug-induced melanonychia is often characterized by grayish, homogeneous pigmentation, sometimes arranged in regular longitudinal lines if the pattern is band-like. The pigmentation generally lacks the asymmetry, color variegation, and irregular borders suggestive of malignancy.[1,2]

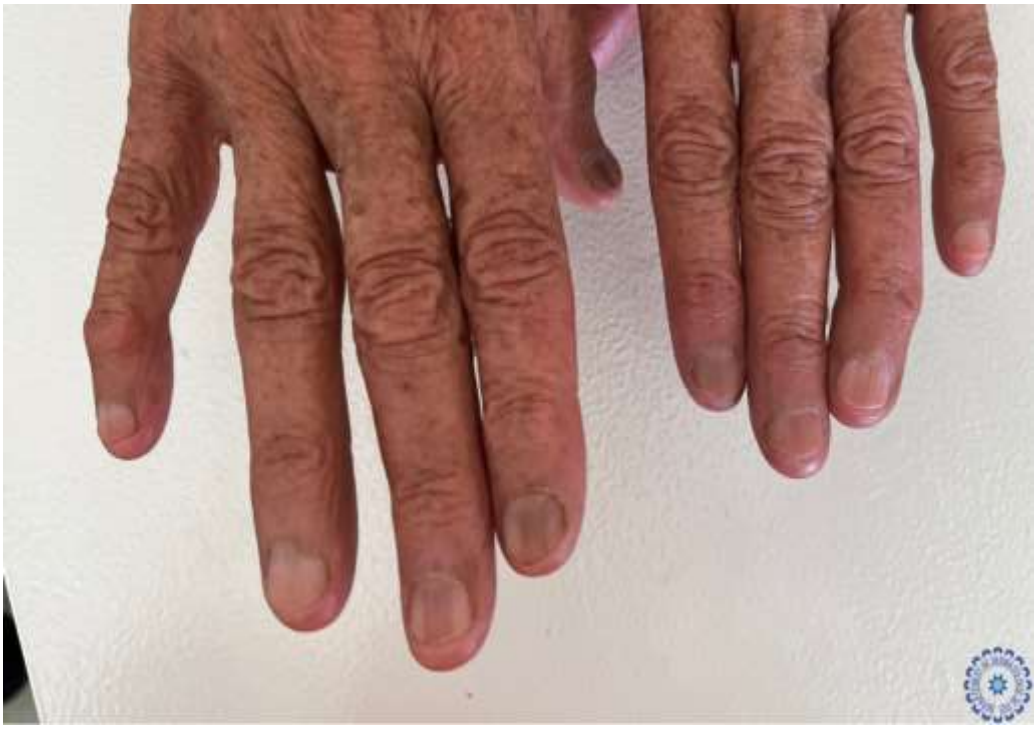

Figure 18 Drug-induced melanonychia in a patient undergoing chemotherapy, presenting with multiple broad longitudinal pigmented bands affecting all fingernails.

d. Post-inflammatory melanonychia:

Post-inflammatory melanonychia occurs in the context of inflammatory dermatoses involving the nail matrix, including cutaneous amyloidosis, chronic radiodermatitis, paronychia, lichen planus, psoriasis, or eczema. The associated inflammatory mediators promote melanogenesis, resulting in the development of light-brown longitudinal bands, which often appear after resolution of the underlying inflammation (Fig. 19).[6,33] Dermoscopically, the bands are gray to brown, regular, and usually narrow, without significant variation in thickness or spacing.[2]

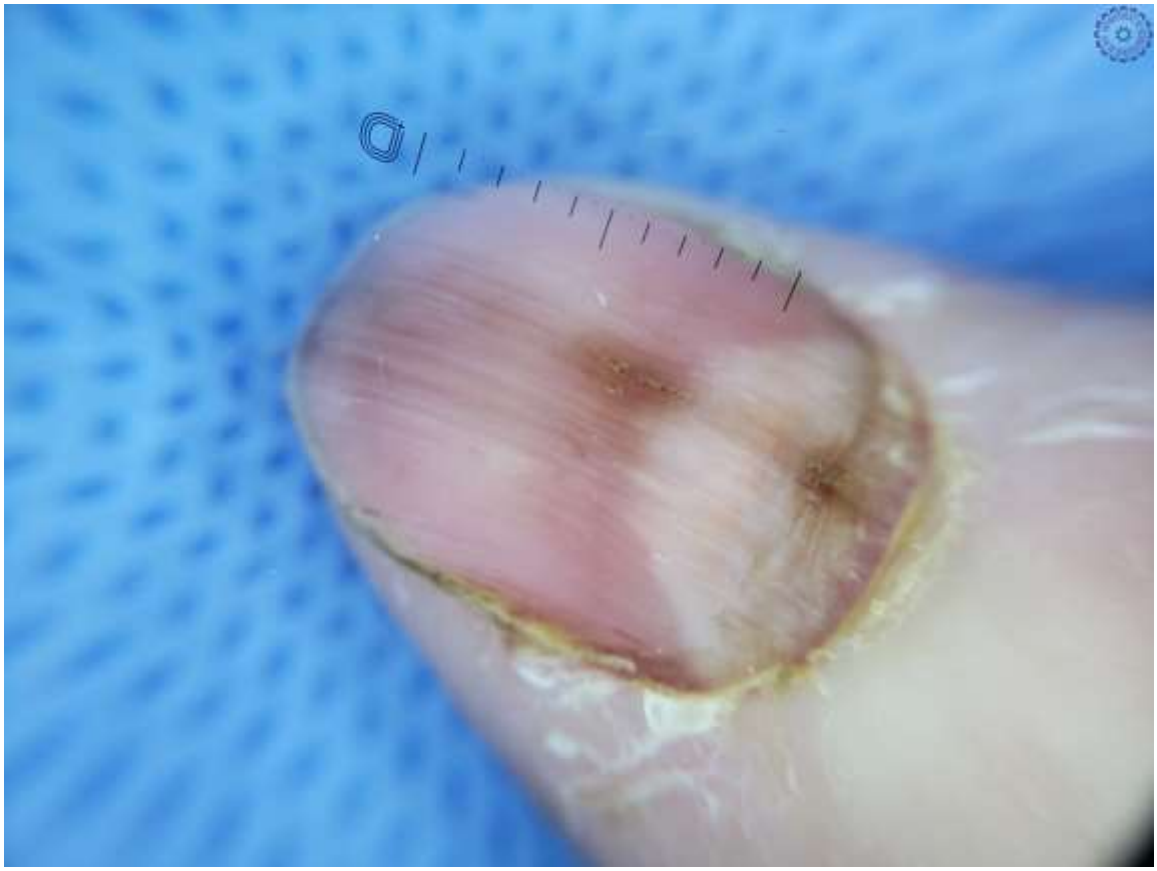

Figure 19 Longitudinal melanonychia in a patient with psoriasis. Dermoscopy shows longitudinal ridging, diffuse erythematous discoloration, irregular brownish pigmentation lacking parallel structure, a fuzzy lunula sign, Beau's lines, and periungual scaling—features consistent with psoriatic nail involvement rather than melanocytic pigmentation.

e. Traumatic melanonychia

Chronic or repetitive trauma is a common cause of LM through activation of melanocytes in the nail matrix, without an increase in their number. This melanocytic activation may result from mechanical friction, pressure, or direct injury, often related to daily habits or footwear. Common triggers include nail biting (onychophagia), picking (onychotillomania), and occupational or sports-related trauma.[17,33]

Frictional melanonychia typically involves the fourth and fifth toenails, particularly in individuals wearing ill-fitting or narrow shoes. It is frequently observed in athletes or those experiencing chronic pressure on the proximal nail fold, especially in the presence of overriding toes.[17,33] The pigmented bands are often brown or gray black with a background of thin, parallel lines. Dermoscopic examination may reveal regular gray bands with parallel striae, sometimes accompanied by signs of trauma such as nail ridging, red spots, or splinter hemorrhages, which further support a traumatic etiology (Fig. 20,21).[1]

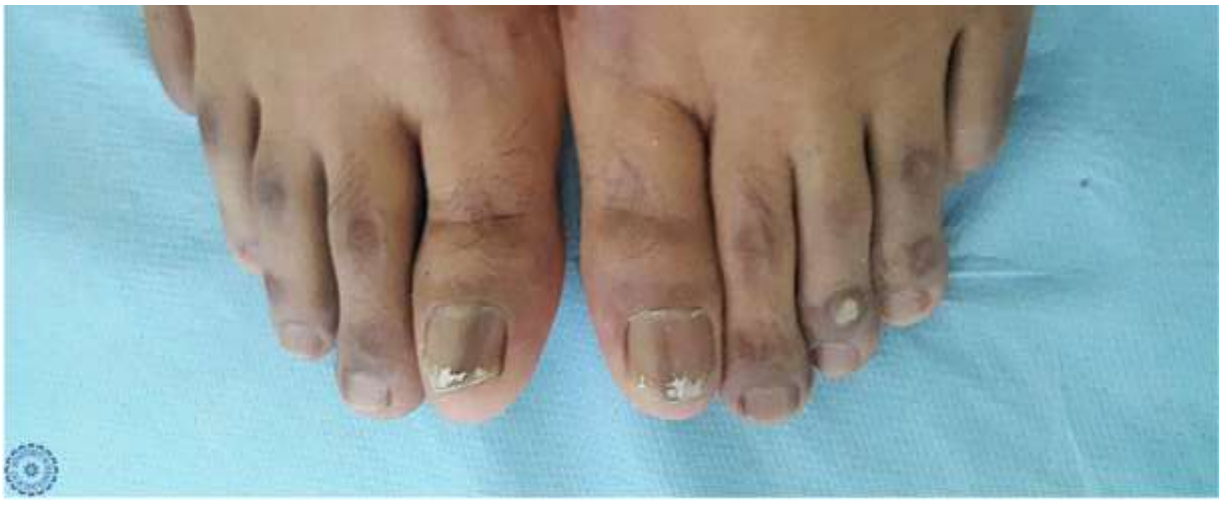

Figure 20 Friction melanonychia associated to calluses on the dorsal aspects of the toes.

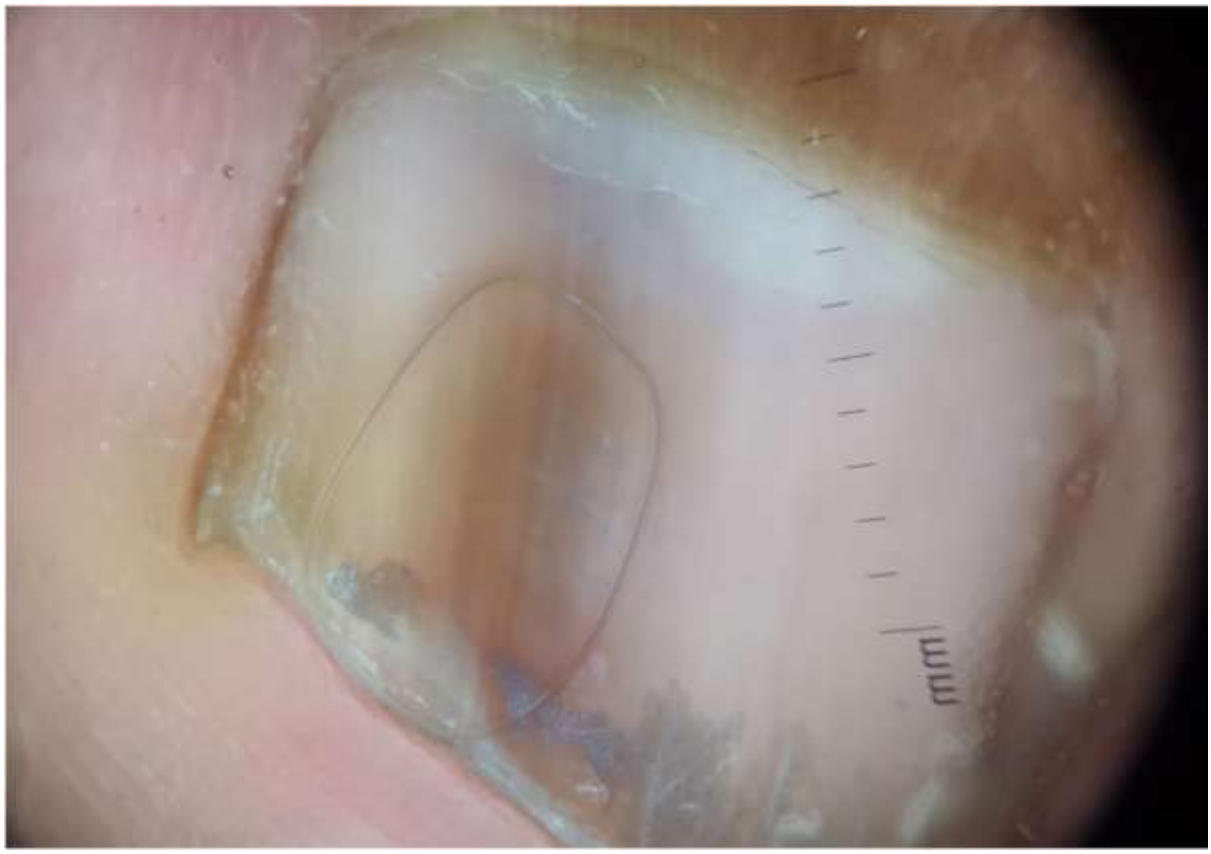

Figure 21 Dermoscopic image showing a light brown longitudinal melanonychia band with regular borders. The pigmentation is faded proximally and accentuated distally, suggesting benign melanocytic activation.

In onychotillomania, mechanical trauma from repeated manipulation of the proximal nail fold induces melanocyte activation, commonly involving multiple digits. Clinical signs such as crusts, wounds, or periungual inflammation are frequently present and help differentiate it from other causes of LM.[1] Nail plate or periungual abnormalities are also common in trauma-induced cases, and the pigmentation often appears symmetric, affecting the lateral or distal aspects of the nails.[33]

f. Melanonychia Secondary to Non-Melanoma Nail Tumors

Melanocytic activation can occur as a reactive phenomenon adjacent to various benign and malignant non-melanocytic tumors of the nail unit. In these cases, the pigmentation does not result from proliferation of melanocytes but rather from their activation, likely triggered by local inflammatory or molecular signaling pathways associated with the tumor microenvironment.

Clinically, this may manifest as longitudinal melanonychia, often raising concern for melanocytic neoplasia. Notable examples include onychomatricoma, onychopapilloma, glomus tumors, squamous cell carcinoma, and verrucous tumors of the nail unit. In these instances, the pigmentation is usually localized and often subtle, although it may mimic patterns seen in melanocytic lesions.[6]

Dermoscopy of these cases often shows regular grayish or brown lines on a homogeneous background, with no signs of melanocytic atypia. Importantly, assessment of the free edge of the nail plate can be particularly informative: localized thickening, keratinous fraying, or abnormal curvature at the free edge is highly suggestive of a non-melanocytic tumor and may help differentiate it from melanocytic etiologies. In such contexts, the presence of structural nail plate abnormalities may even exclude a melanocytic origin, especially when characteristic dermoscopic or clinical features of a tumor are present.[2,4]

In rare cases, melanocytic activation may also result from nonmelanocytic tumors of the nail unit, such as onychomatricoma, Bowen's disease, myxoid pseudocyst, basal cell carcinoma, subungual fibrous histiocytoma, verruca vulgaris, or subungual linear keratosis.[6]

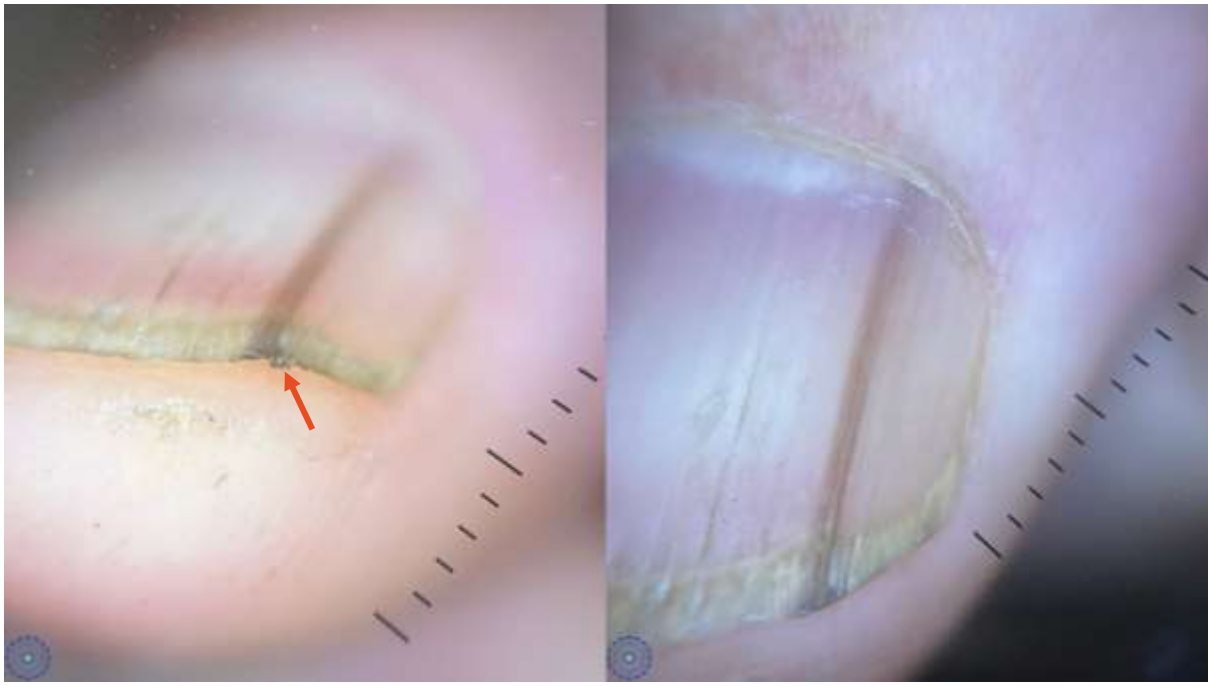

Figure 22 Onychopapilloma presenting as longitudinal melanonychia. Dermoscopy of the nail plate reveals a homogeneous light brown band composed of parallel thin brown lines, while examination of the free edge shows localized hyperkeratosis (red arrow).

2. Melanocytic Proliferation

Melanocytic proliferation is characterized by an increased number of melanocytes in the nail matrix, either benign or malignant. These proliferations typically originate in the proximal matrix and produce darker pigmentation, more superficial in the nail plate, resulting in brown to black bands.

a. Benign

- Nail Matrix Nevi

Melanocytic nevi of the nail matrix are benign proliferations of melanocytes, most commonly diagnosed in children and young adults.[34] They usually present as a single, stable longitudinal melanonychia, often affecting the thumbs or great toes.[2,11] Clinically, the pigmentation is generally uniform in color and distribution. Dermoscopically, these nevi typically display regular, parallel, and evenly spaced brown lines that are thin and homogeneous, without variation in color, width, or spacing—features that are reassuring for benignity (Fig. 23).[1,24,34] However, congenital nail matrix nevi may present as broader bands with irregularities in color or line thickness on dermoscopy, while still representing benign lesions (Fig. 24).[4,27,34,35] Pseudo-Hutchinson's sign, a benign finding in which pigmentation appears to extend onto the proximal or lateral nail folds, is often observed; this is due to pigment visibility through the translucent cuticle, rather than true melanocyte invasion of the periungual skin.[1]

Figure 23 Clinical and dermoscopic examination of a nail matrix nevus. A longitudinal pigmented band is observed, with ***parallel, regular brown lines*** *consistent in color and thickness, characteristic of a benign melanocytic nevus. Dermoscopy reveals a* ***pseudo-Hutchinson sign****, corresponding to pigment visible through the transparent proximal nail fold, without true periungual invasion.*[4]

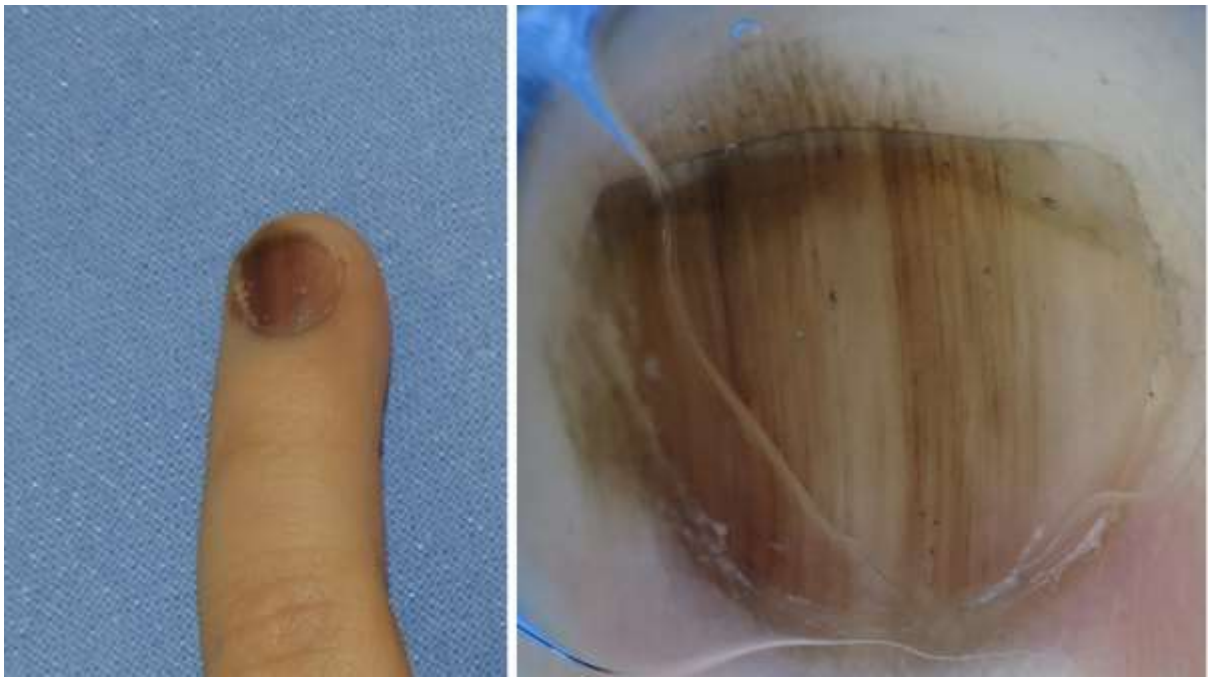

Figure 24 A 4-year old child with a nail matrix congenital nevus resulting in a highly asymmetric pigmentation of the nail plate that expands also to the skin of the lateral and distal nail fold. The pigmentation of the periungual skin of the distal nailfold is typified by a characteristic fibrillar pattern, which typically results for subungual congenital nevi.[4]

Histologically, nail matrix nevi may show junctional nests of melanocytes within the matrix epithelium, and unlike lentigines, are characterized by both proliferation and slight architectural organization (Fig. 25).[11,29]

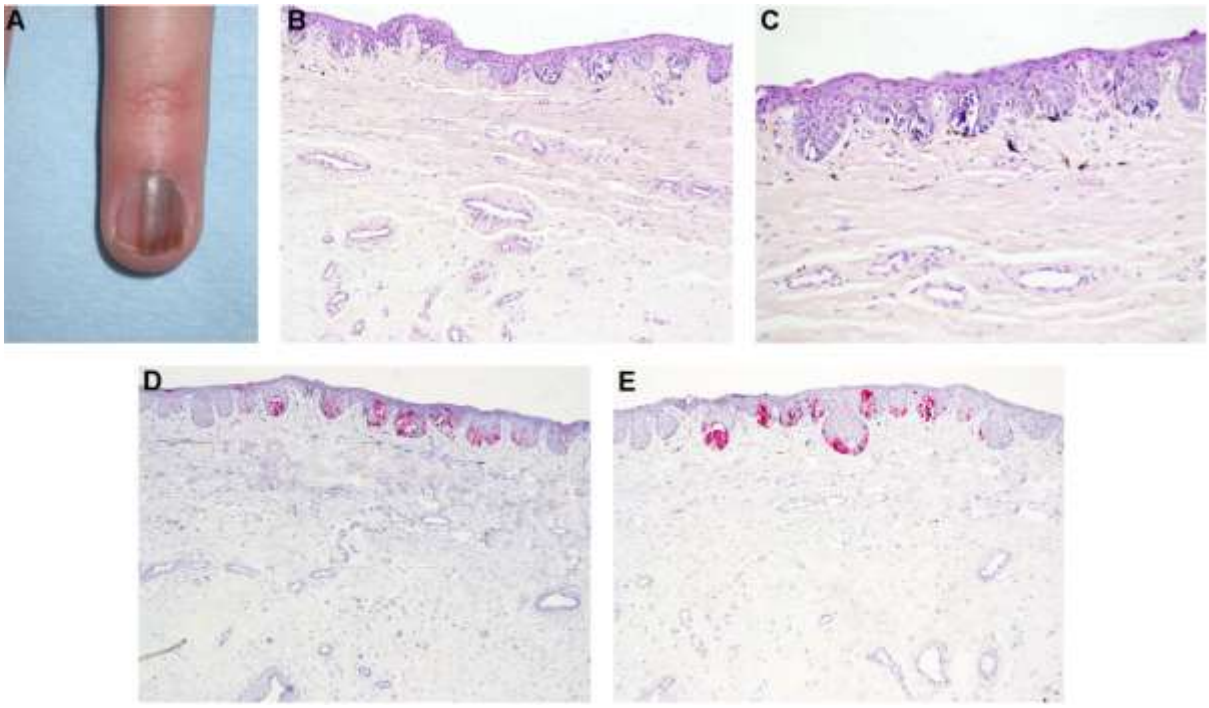

Figure 25 Nevus. A. Long-standing large longitudinal melanonychia with recent changes in a 38-year-old woman. B. Matrix square: pigmented nests. C. Detail: pigmented nests and isolated melanocytes in basal and suprabasal positions. D. HMB45: nests and melanocytes

Despite their benign nature, nail matrix nevi should be monitored for changes in width, color, or pattern—especially in adult patients—since early melanoma may sometimes mimic a nevus.[2,34]

- Nail Lentigo

Lentigo of the nail unit is a benign melanocytic hyperplasia characterized histologically by an increased number of melanocytes along the basal layer of the proximal nail matrix, without the formation of nests and with minimal or

no cytologic atypia.[29] It often presents clinically as a longitudinal melanonychia, typically gray to light brown, reflecting the limited melanin production and superficial melanin distribution. The dermoscopic appearance usually shows thin, regular, and parallel lines with homogeneous spacing and color, resembling patterns seen in melanocytic activation.[24] The grayish hue observed in some cases can be attributed to the Tyndall effect from melanin located in the superficial layers of the nail plate (Fig. 26).[2] Despite being a true melanocytic proliferation, the absence of architectural disorder and cytologic atypia distinguishes lentigo from subungual melanoma, both histologically and dermoscopically.[29] Careful assessment is crucial, as lentigo may occasionally mimic early melanoma, particularly when pigmentation is irregular or when the band appears in an older individual.[2,24]

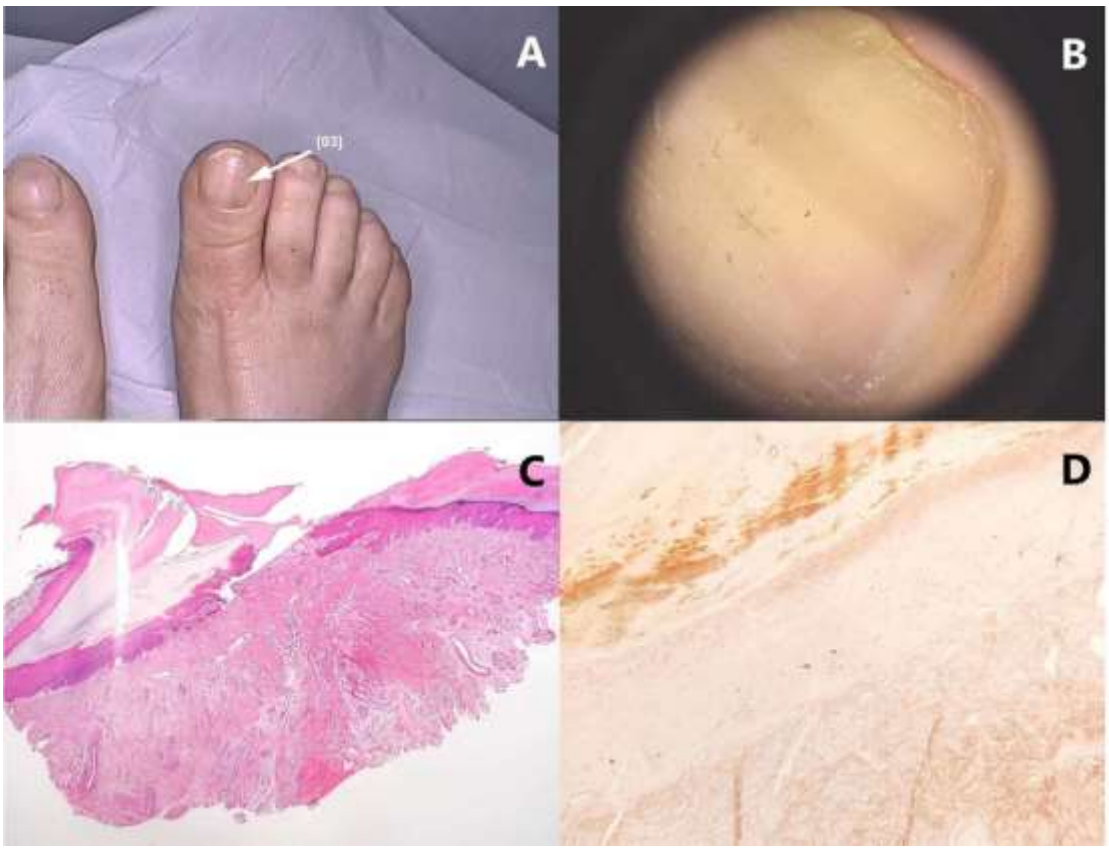

Figure 26 Nail apparatus lentigo: (A) Macroscopic image. (B) Dermoscopic image that reveals a longitudinal, light brown band. (C) Longitudinal nail biopsy of a nail matrix lentigo – melanocytes are not observed on hematoxylin-eosin staining. (D) Fontana-Masson stained sections show minimal pigmentation

b. Malignant

Subungual melanoma is a rare but potentially life-threatening malignancy originating from the nail matrix, most commonly affecting adults, with a predilection for the thumb and great toe. Clinically and dermoscopically, it poses significant diagnostic challenges, especially in its early stages. Dermoscopic features suggestive of malignancy include a pigmented longitudinal band with irregular lines that vary in thickness, spacing, and color (brown, black, gray), often accompanied by asymmetry and loss of

parallelism.[36] These bands frequently show progressive widening over time and may be associated with Hutchinson's sign (Fig. 27).[5]

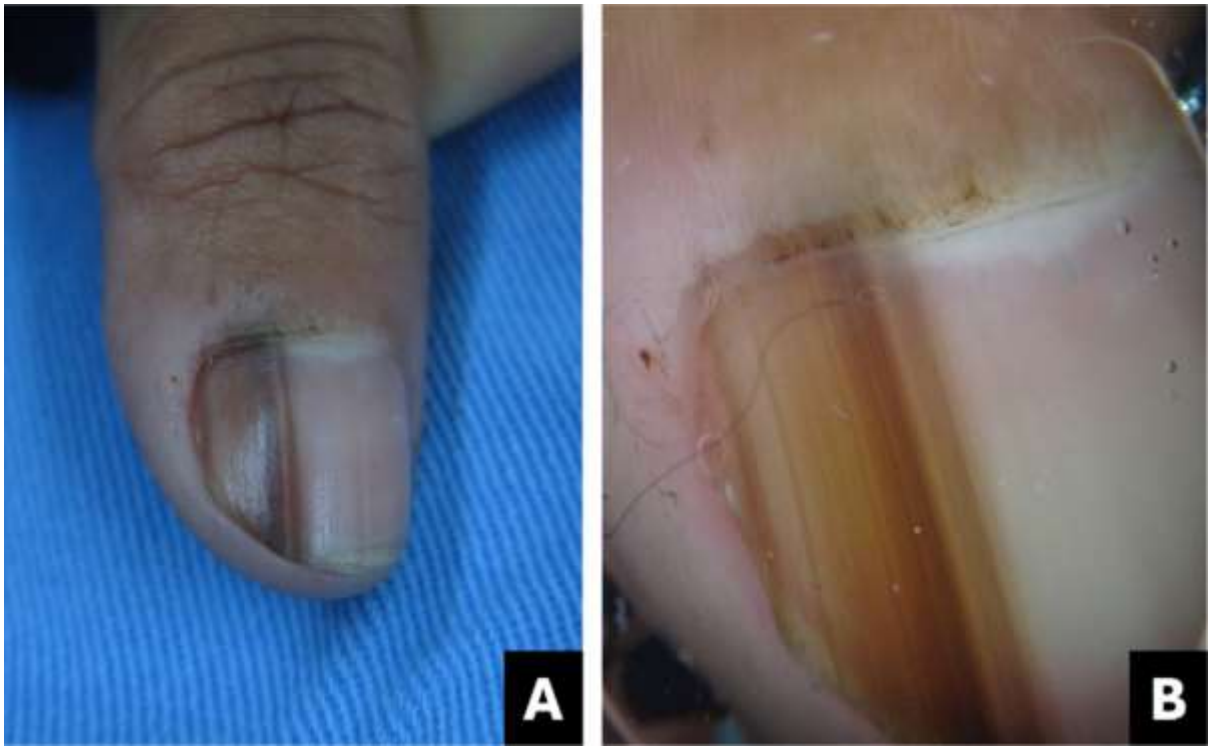

Figure 27 Melanoma. (A) Clinical: light brown to darkened longitudinal melanonychia; (B) Onychoscopy: light to dark brown irregular streaks with apparent parallelism, pigment extends beyond the cuticle (Hutchinson's Sign)

Micro-Hutchinson's sign, visible only on dermoscopy, and pigment granularity (suggesting melanin dispersion within the nail plate or matrix) are additional red flags (Fig. 28).[29] Ulceration of the nail unit and nail dystrophy may also occur in more advanced cases.

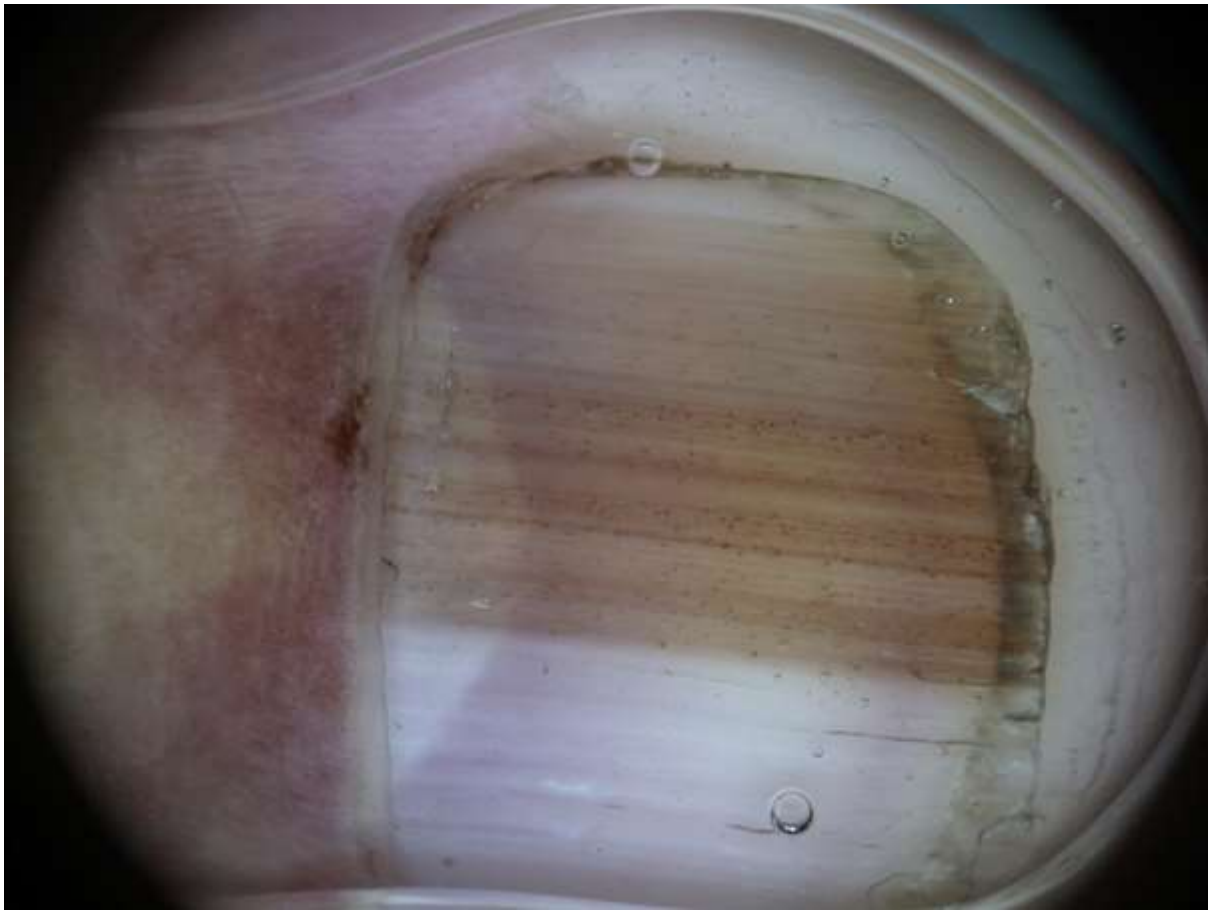

*Figure 28 Dermoscopic image of a melanoma of the thumbnail showing an **irregular pattern of longitudinal lines** over a **brown background pigmentation**. Additional features include **irregularly distributed pigmented globules** and a **micro-Hutchinson sign**, all visible only under dermoscopic examination.[37]*

Histologically, subungual melanoma must be distinguished from benign melanocytic proliferations such as subungual lentigo or nail matrix nevi, which typically exhibit uniform melanocyte distribution without atypia or pagetoid spread.[29] In contrast, melanoma often shows lentiginous proliferation with cytologic atypia, nuclear pleomorphism, and occasionally dermal invasion (Fig. 29).[29] Therefore, clinical, dermoscopic, and histopathological integration is critical to avoid misdiagnosis and delayed treatment.[5,22]

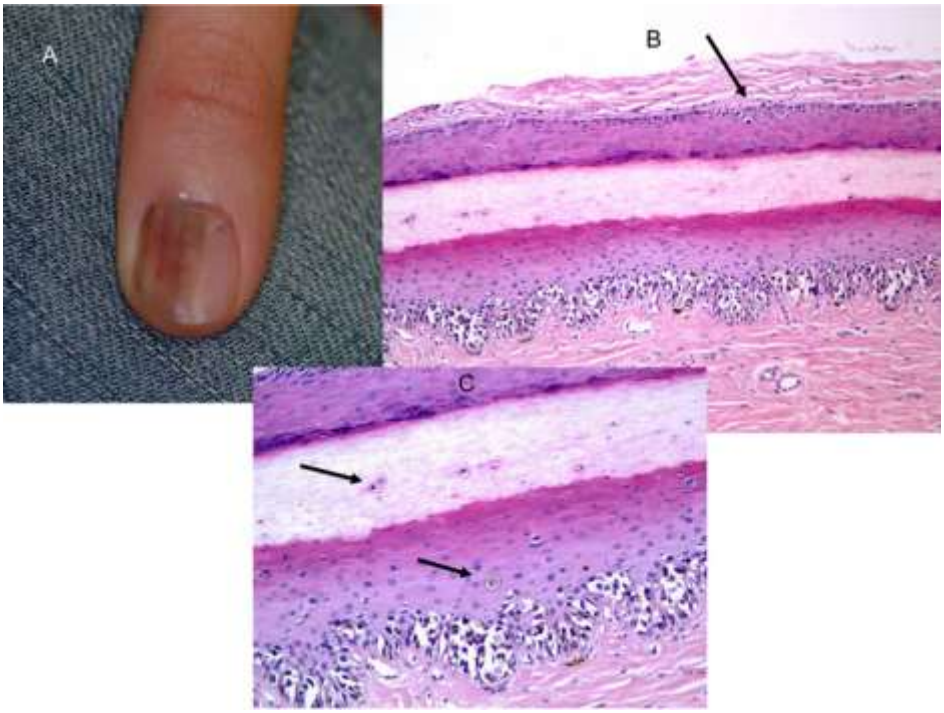

Figure 29 Melanoma in situ. (A) Clinical, a broader inhomogeneous band, with Hutchinson's sign at proximal nail fold (Courtesy of Jeffrey Sugarman, MD, PhD); (B) Confluence of atypical melanocytes, with involvement also of eponychial (ventral nail fold) epithelium, arrow, a correlate of Hutchinson's sign (hematoxylin and eosin, 100x);and (C) Scatter of melanocytes within the upper matrical epithelium and visible within the nail plate itself, arrows (hematoxylin and eosin, 400x).[11]

3. Non-Melanocytic Causes

In these cases, pigmentation of the nail plate occurs due to other pigments or external factors unrelated to melanin.

a. Infectious[38]

- **Fungal infections (e.g., onychomycosis)** with melanin-producing fungi can cause dark pigmentation.
- **Bacterial infections**, especially by *Pseudomonas aeruginosa*, may lead to green-black discoloration.

b. Exogenous pigments:

External substances such as dyes, inks, tobacco, or chemicals can cause pseudo-melanonychia. These typically stain the nail surface and may be removed or fade over time.[36]

OBJECTIVES

The objectives of this thesis are to:

Main Objectives

- Describe the dermoscopic patterns observed in various forms and causes of melanonychia.:
- Compare dermoscopic characteristics across diagnostic categories to identify distinguishing features.

Secondary Objective

- Assess the diagnostic value of dermoscopy in differentiating benign from malignant causes.

MATERIALS AND METHODS

I. Study Design

This was a retro-prospective, observational, descriptive, and analytical study conducted in the Dermatology Department of Hassan II University Hospital. The study included both retrospectively and prospectively collected cases of melanonychia, focusing on clinical and dermoscopic features at the time of presentation.

II. Study Population

The study included all patients who presented with melanonychia affecting one or more nails and underwent dermoscopic evaluation, A total of 160 patients were included, corresponding to 548 melanonychia-affected nails analyzed.

Inclusion criteria:

- Clinically visible melanonychia (longitudinal, transverse, or diffuse);
- Availability of dermoscopic examination, documented with at least one stored dermoscopic image.
- Sufficient clinical data, including age, sex, lesion location, and medical history. (for retrospective cases)

Exclusion criteria:

- Melanonychia due to obvious exogenous causes (e.g., henna, nail polish) without diagnostic ambiguity
- Incomplete clinical or dermoscopic data.
- History of prior treatment of the affected nail before dermoscopic evaluation.

III. Data Collection

For each included patient, the following information was collected from medical records:

- **Demographic data**: age, sex, and skin phototype (Fitzpatrick classification);
- **Clinical characteristics**: number and location of affected nails, duration of pigmentation, mode of onset (sudden or progressive), presence of associated nail changes (dystrophy, thickening), and pigmentation of the periungual skin;
- **Clinical presentation of melanonychia**: type (Longitudinal, transversal, total, and non-specific for cases that can't be included in any of the previous categories), pattern, color, width, and number of bands per nail;
- **Relevant history**: history of trauma (e.g., nail-biting, occupational exposure), medication use, personal or family history of melanoma, and family history of melanonychia.

Note: In cases of polydactylic melanonychia where all nails were affected and presented similar bands, we recorded all affected nails in the patient data. However, for dermoscopic analysis, only a representative sample of 2 to 3 nails per patient was documented and included in the dataset of 548 nails. This approach was used to avoid redundancy and ensure a practical yet representative evaluation of dermoscopic features.

IV. Dermoscopic Analysis

Dermoscopic examination was performed using either a DermLite DL4 or DL5 dermatoscope, coupled with an iPhone camera, with polarized light in contact mode, with or without immersion fluid. All images were digitally archived.

The following dermoscopic features were systematically assessed:

- **Band characteristics**: width (for longitudinal melanonychia), localization (proximal or distal for transverse bands), shape (rectangular, triangular, reverse triangular, arciform or nonspecific), color, and overall pattern;
- **Border definition**: well-sharp or blurred margins;
- **Arrangement of pigmented lines**: evaluation of parallelism, line width, and spacing;
- **Presence of alarming features**: such as Hutchinson's sign, microhemorrhages, asymmetry, or irregular pigmentation;

- **Additional diagnostic clues**: subungual hyperkeratosis (localized or diffuse), pachyonychia, nail surface scaling, or excessive nail curvature (hypercurvature).
- **Evaluation of the free edge**: presence and extent of pigmentation on the hyponychium or ventral surface of the nail plate, and any associated keratotic changes.

Image analysis was conducted **independently** by two dermatologists experienced in dermoscopy.

V. Etiological Classification

Based on clinical and dermoscopic features, and when applicable, histopathologic data, melanonychia cases were classified into:

1. Melanocytic Melanonychia

This group includes pigmentation due to melanin produced by melanocytes, subdivided into:

a. Melanocytic activation (without melanocyte proliferation):

- Racial or ethnic pigmentation
- Drug-induced pigmentation
- Post-inflammatory melanonychia
- Systemic diseases (e.g., Addison's disease)
- Frictional or traumatic causes

b. Melanocytic proliferation (benign or malignant):

- Nail matrix nevus
- Lentigo
- Subungual melanoma

2. Non-Melanocytic Melanonychia

This group includes pigmentation unrelated to melanin production, involving exogenous pigments or blood:

- **Subungual hemorrhages**
- **Fungal melanonychia**
- **Bacterial melanonychia (e.g., *Pseudomonas* infection)**
- **Exogenous pigmentation** (e.g., ink, dyes, chemicals, dirt)

When the diagnosis remained uncertain or when melanoma was suspected, biopsy of the nail matrix was performed. However, due to the potential risk of permanent nail dystrophy, biopsy was limited to cases with significant clinical or dermoscopic suspicion.

VI. Statistical Analysis

Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics. Qualitative variables were expressed as frequencies and percentages, while quantitative variables were presented as means ± standard deviation (SD). Statistical tests (e.g., Chi-square test, Fisher's exact test, Student's t-test, or ANOVA) were applied to assess correlations between clinical, dermoscopic, and etiological variables. A p-value < 0.05 was considered statistically significant.

RESULTS

I. Descriptive study

1. Study population:

In this study, 548 melanonychia-affected nails from 160 patients were included.

a. Age Distribution:

The mean age of the patients was 50.18 years, with a standard deviation of 16.02, and the age ranged from 3 to 80 years.

b. Sex Distribution:

Among the 160 patients, 64 were male (40%) and 96 were female (60%), resulting in a female-to-male ratio of approximately 1.5:1 (Fig. 30).

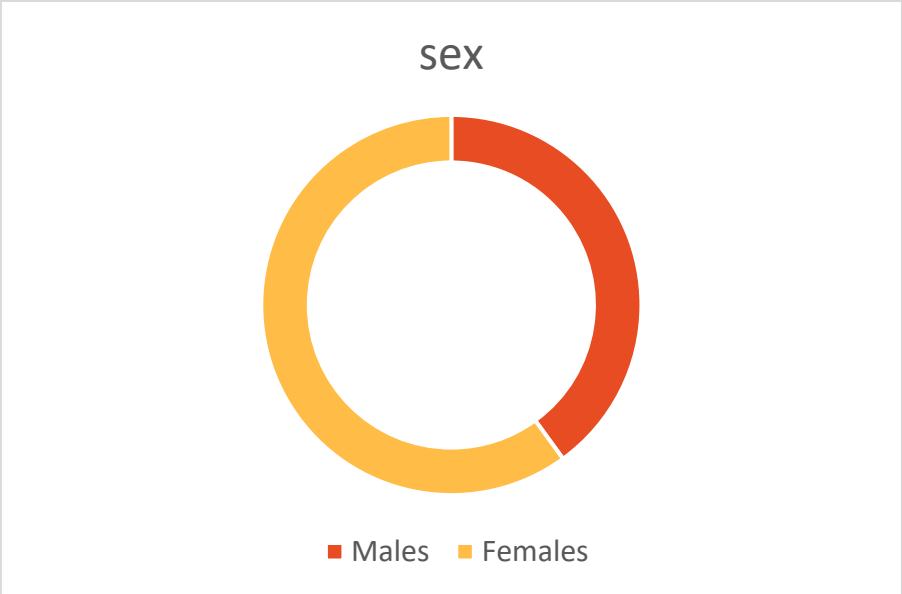

Figure 30 Distribution of the study population according to sex.

c. Phototype Distribution:

Regarding skin phototype distribution (based on the Fitzpatrick classification), most patients had phototype IV (56.25%, 90 patients), followed by phototype III (27.5%, 44 patients), phototype V (13.75%, 22 patients), and phototype VI (3.1%, 5 patients), as seen in Figure 31.

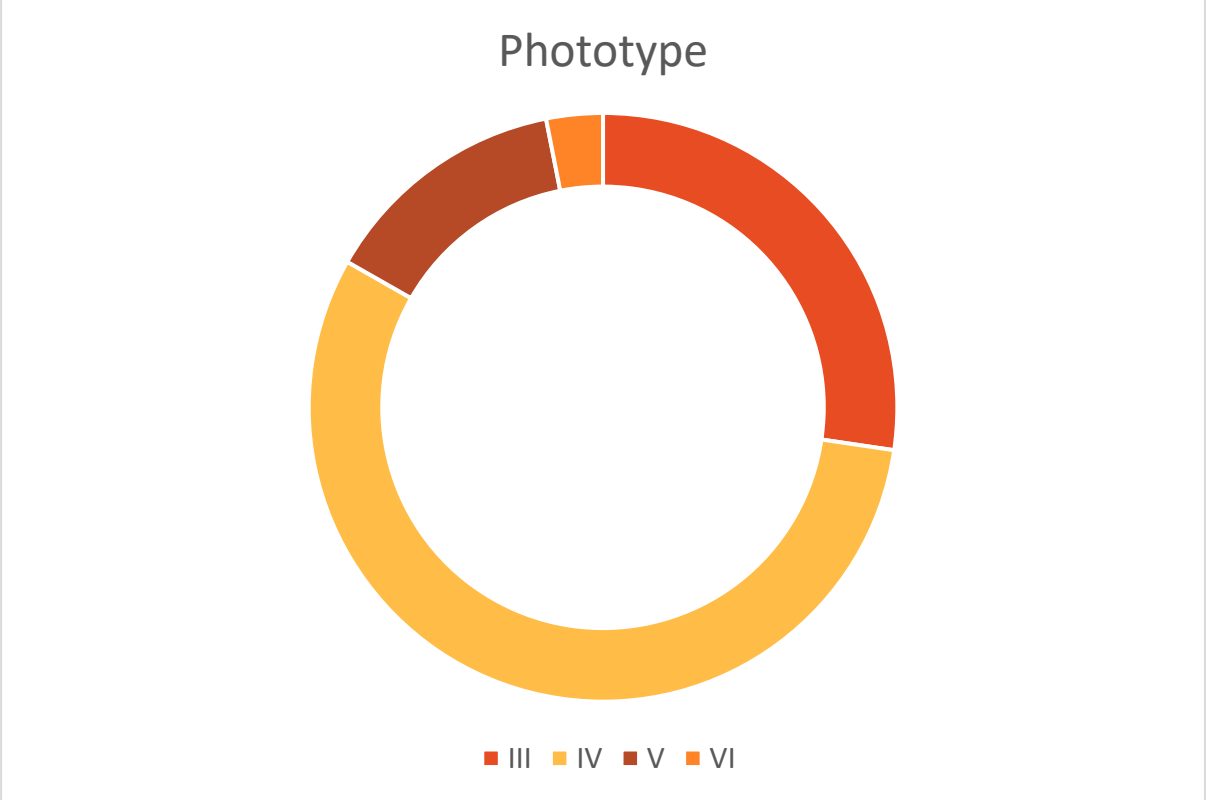

Figure 31 Distribution of the study population according to Fitzpatrick skin type

d. Familial History of Melanonychia:

A family history of melanonychia of the same type was reported in 20 patients (12.5%).

2. Clinical Characteristics:

a. Monodactylic vs Polydactylic Melanonychia:

Of the 160 patients studied, 77 (48.1%) presented with monodactylic melanonychia, while 83 (51.9%) exhibited polydactylic involvement. In total, 548 nails were affected: 108 in monodactylic cases and 440 in polydactylic cases. The most commonly involved digits in monodactylic melanonychia were the thumb (29 cases), big toe (24 cases), and index finger (10 cases). Notably, 26 patients with polydactylic melanonychia had all 20 nails affected (Fig. 32).

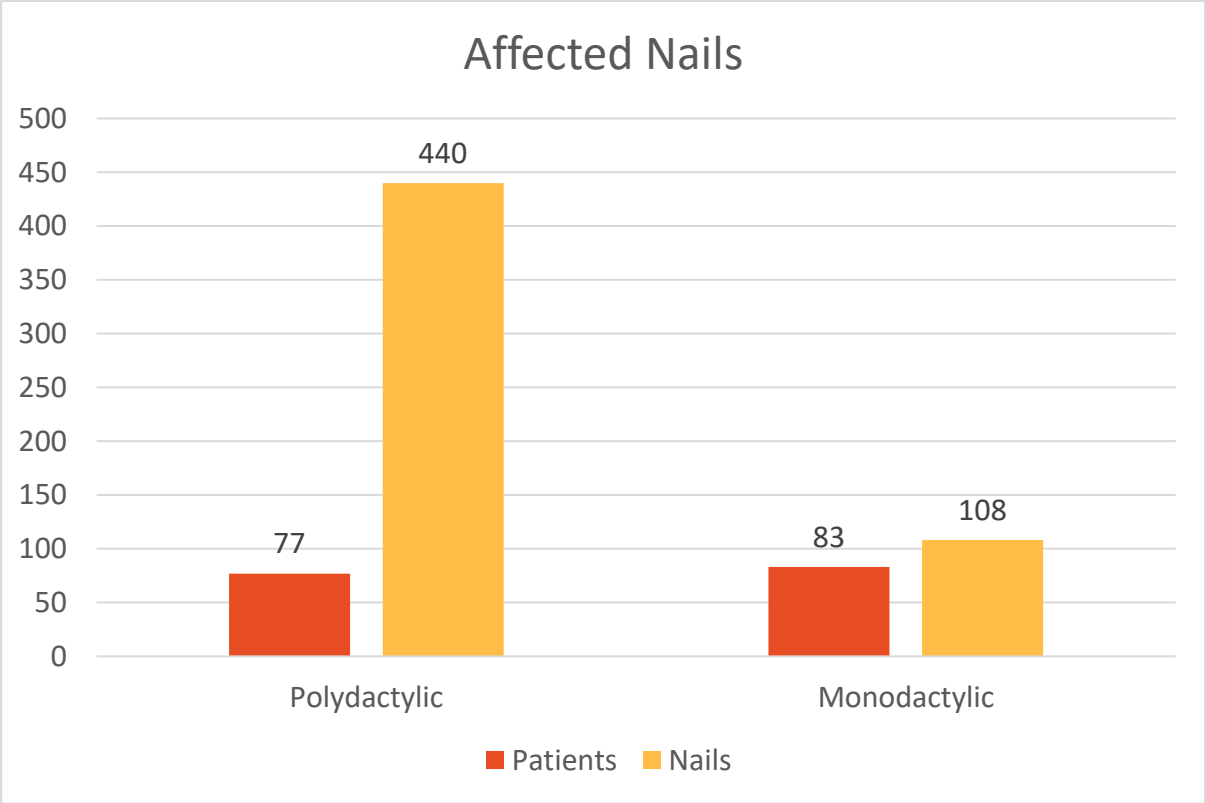

Figure 32 Classification of patients based on the extent of nail involvement: monodactylic versus polydactylic.

b. Types of Melanonychia:

Of the 548 melanonychia-affected nails, longitudinal melanonychia was most common (Fig. 33), seen in 457 nails (83.4%). Among these, bands involved less than one-third of the nail width in 367 cases (80.3%), between one-third and two-thirds in 61 cases (13.3%), and over two-thirds in 29 cases (6.3%). Transverse melanonychia occurred in 55 nails (10%), with 14 affecting the entire nail width, 25 limited to the proximal portion, 14 to the distal portion, and 2 non-specific location (Fig. 34). Total melanonychia, involving complete nail pigmentation, was noted in 19 nails (3.5%). In comparison, 17 nails (3.1%) had unclassifiable, nonspecific patterns (Fig. 35). Multiple melanonychia bands appeared in 267 nails, mostly longitudinal, though some exhibited mixed patterns, reflecting complex presentations.

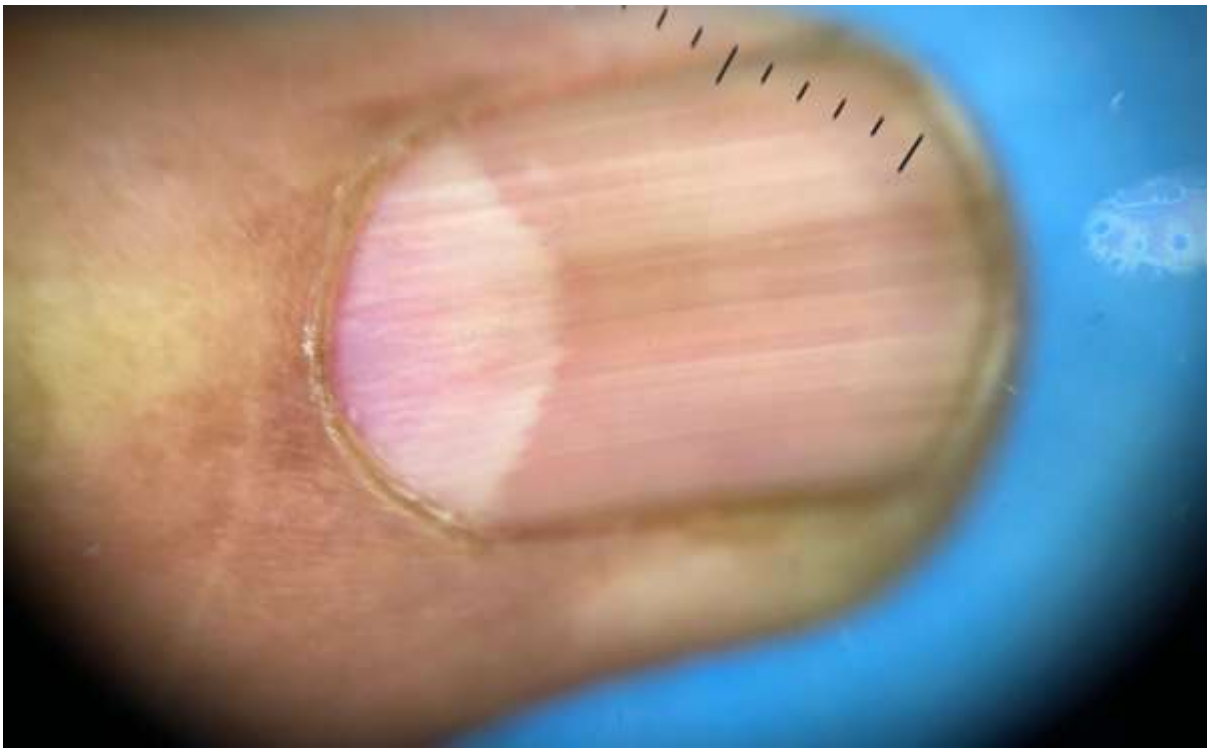

Figure 33 Longitudinal Melanonychia

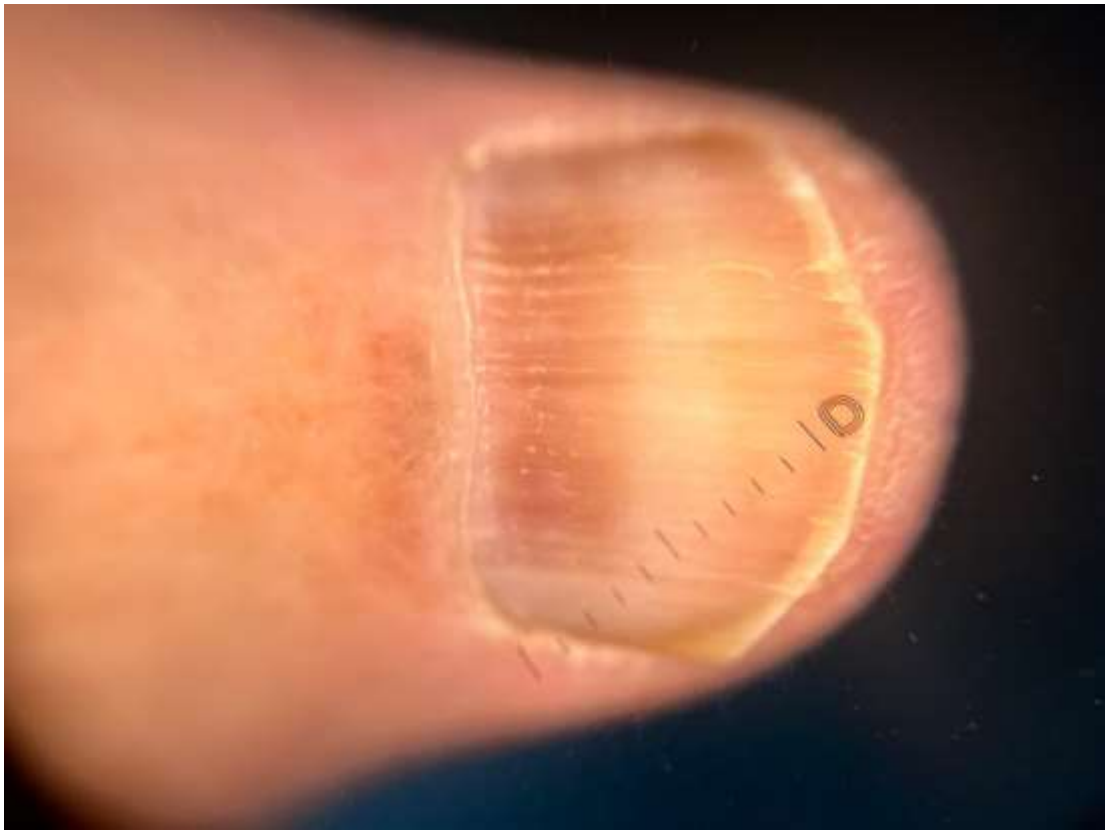

Figure 34 Drug-induced transverse melanonychia showing alternating pigmented and non-pigmented nail bands.

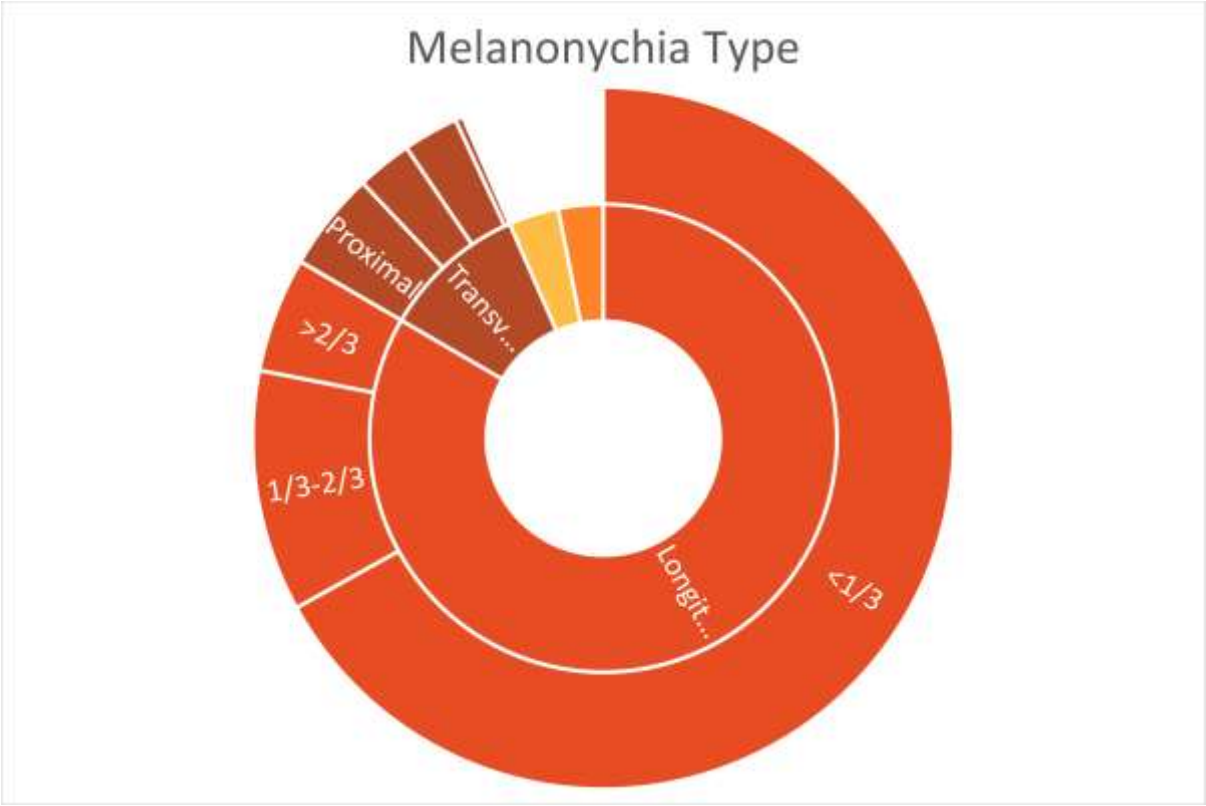

Figure 35 Distribution of melanonychia according to melanonychia type

c. Band shape:

The shape of the melanonychic bands varied across the affected nails (Fig. 36). The most common band shape was rectangular (Fig. 37), which was observed in 440 nails (80.5%). This shape was characterized by a consistent width along the length of the band, with no significant variation.

Other shapes included reverse triangular bands (Fig. 38), observed in 28 nails (5.1%), and triangular bands (Fig. 39), seen in 6 nails (1.1%). Arciform bands, with a curved or arch-like appearance (Fig. 40), were present in 17 nails (3.1%). Additionally, non-specific shapes (Fig. 41) were noted in 57 nails (10.4%), where the band could not be classified into any of the defined categories.

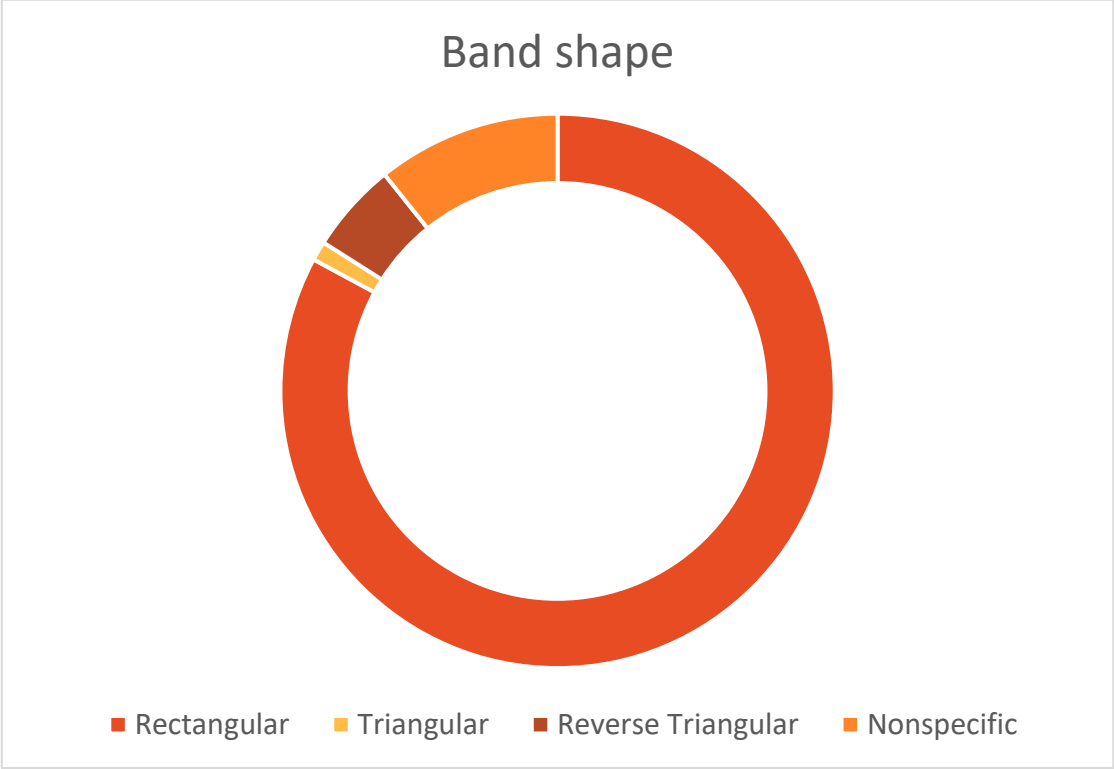

FIGURE 36 DISTRIBUTION OF MELANONYCHIA ACCORDING TO BAND SHAPE

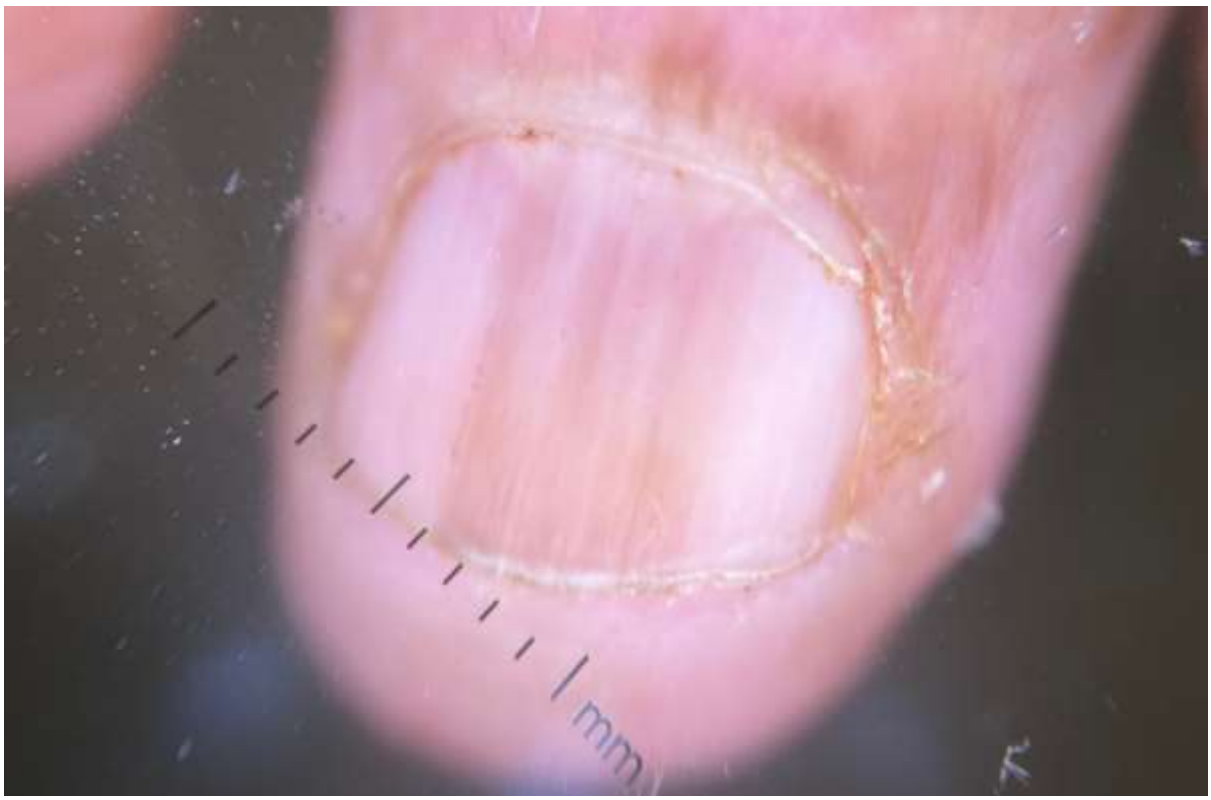

Figure 37 Rectangular melanonychia shape

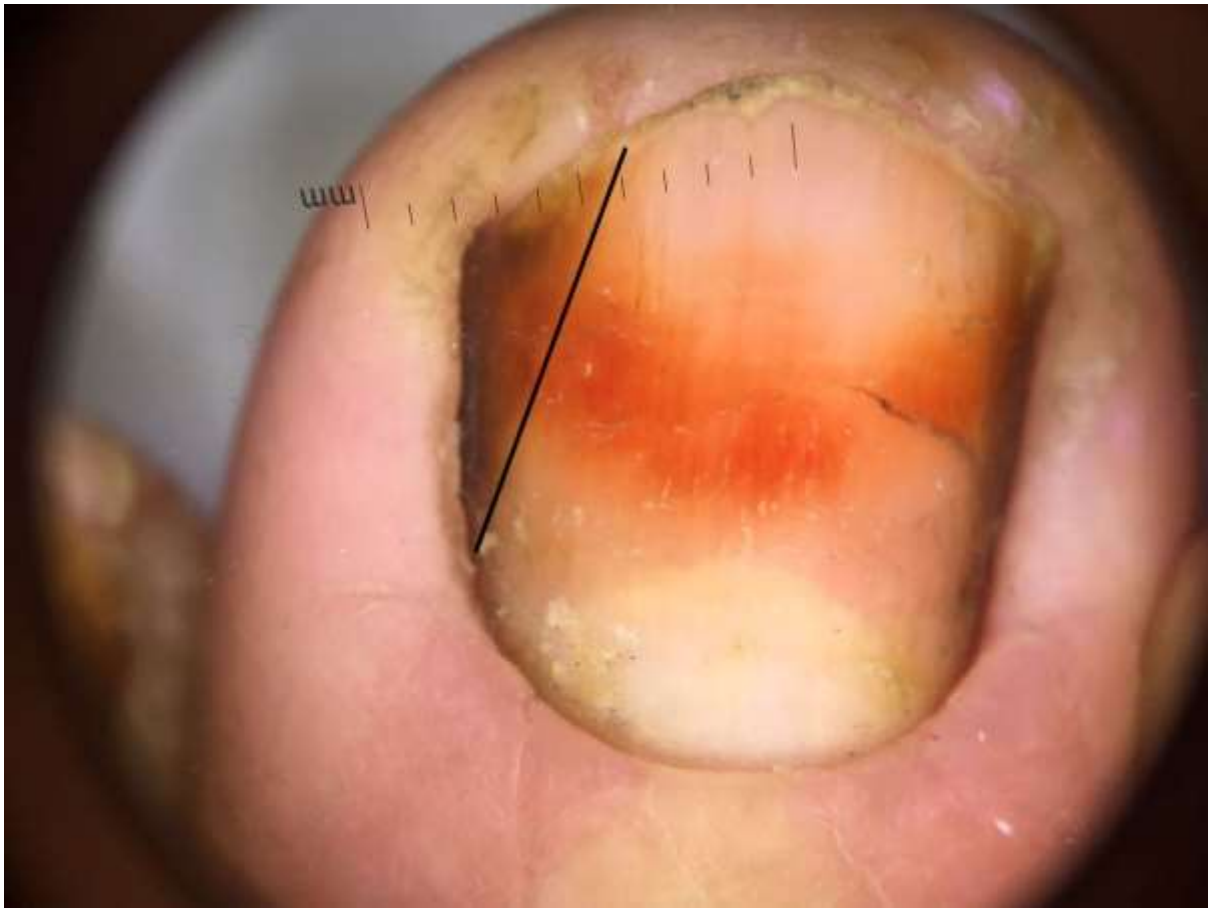

Figure 38 Reverse triangular melanonychia observed in a case of onychomycosis

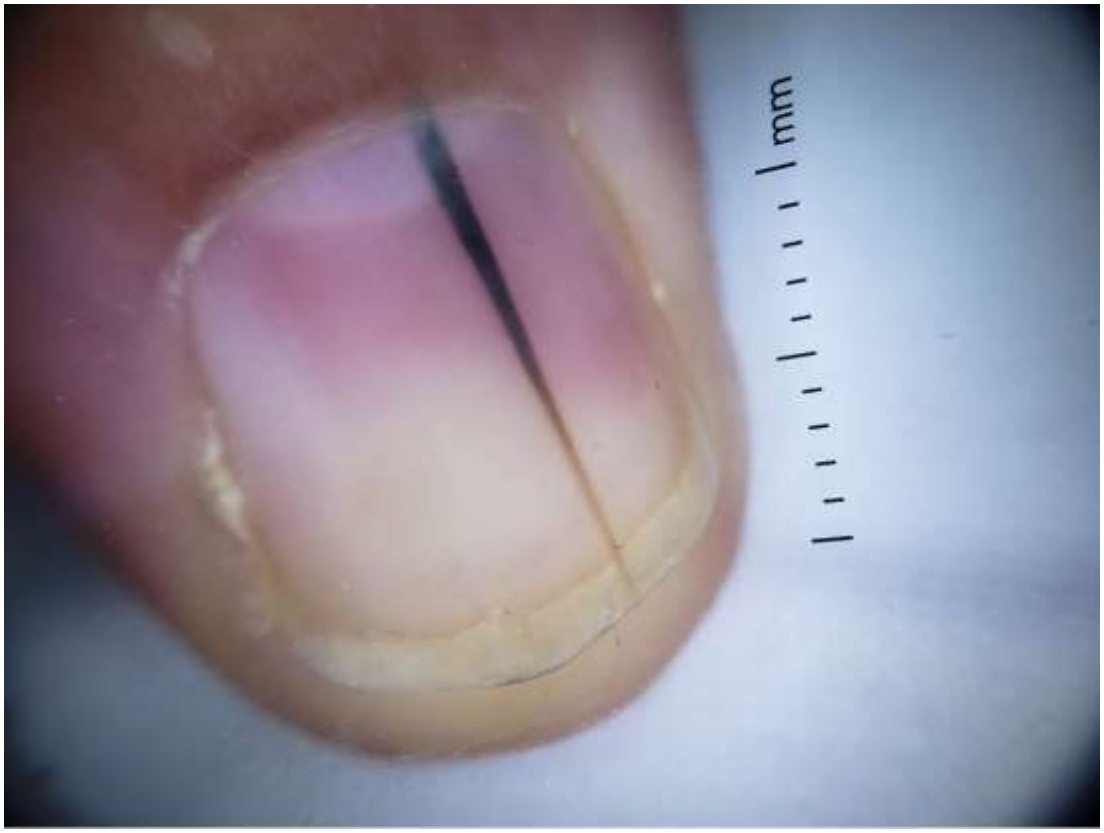

Figure 39 Triangular melanonychia observed in a case of acquired nevi.

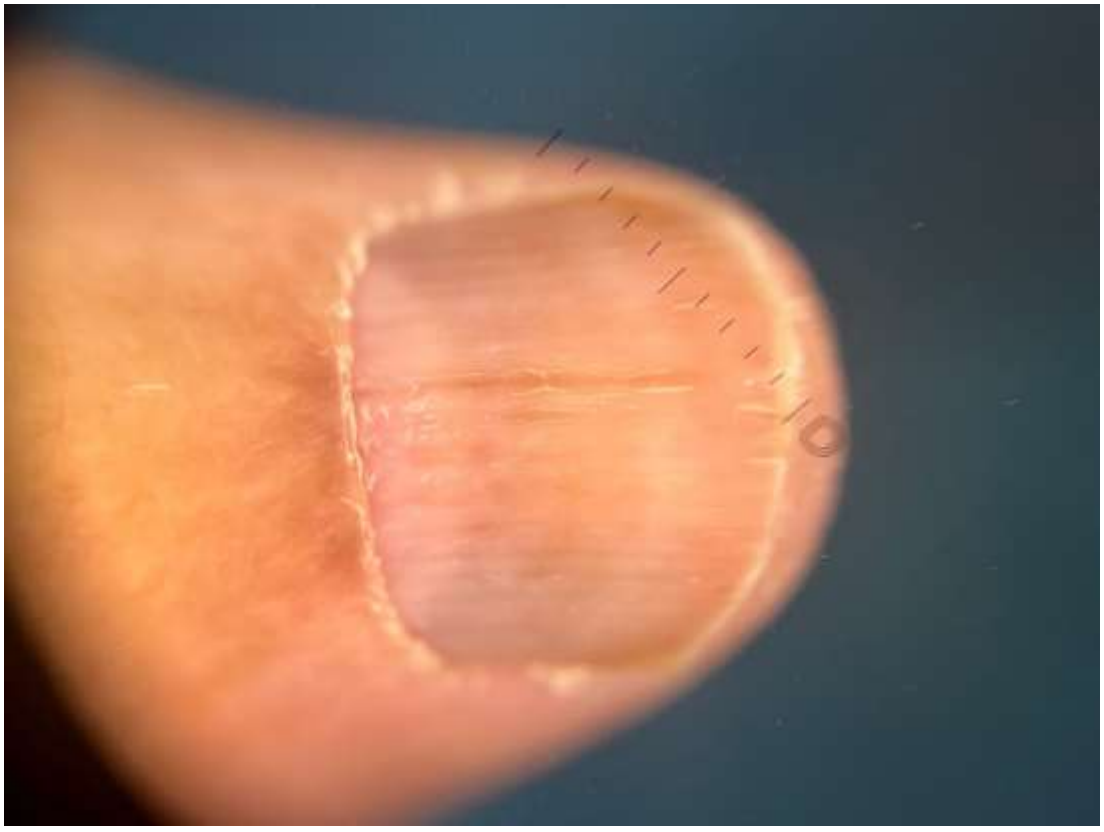

Figure 40 Arciform transverse bands

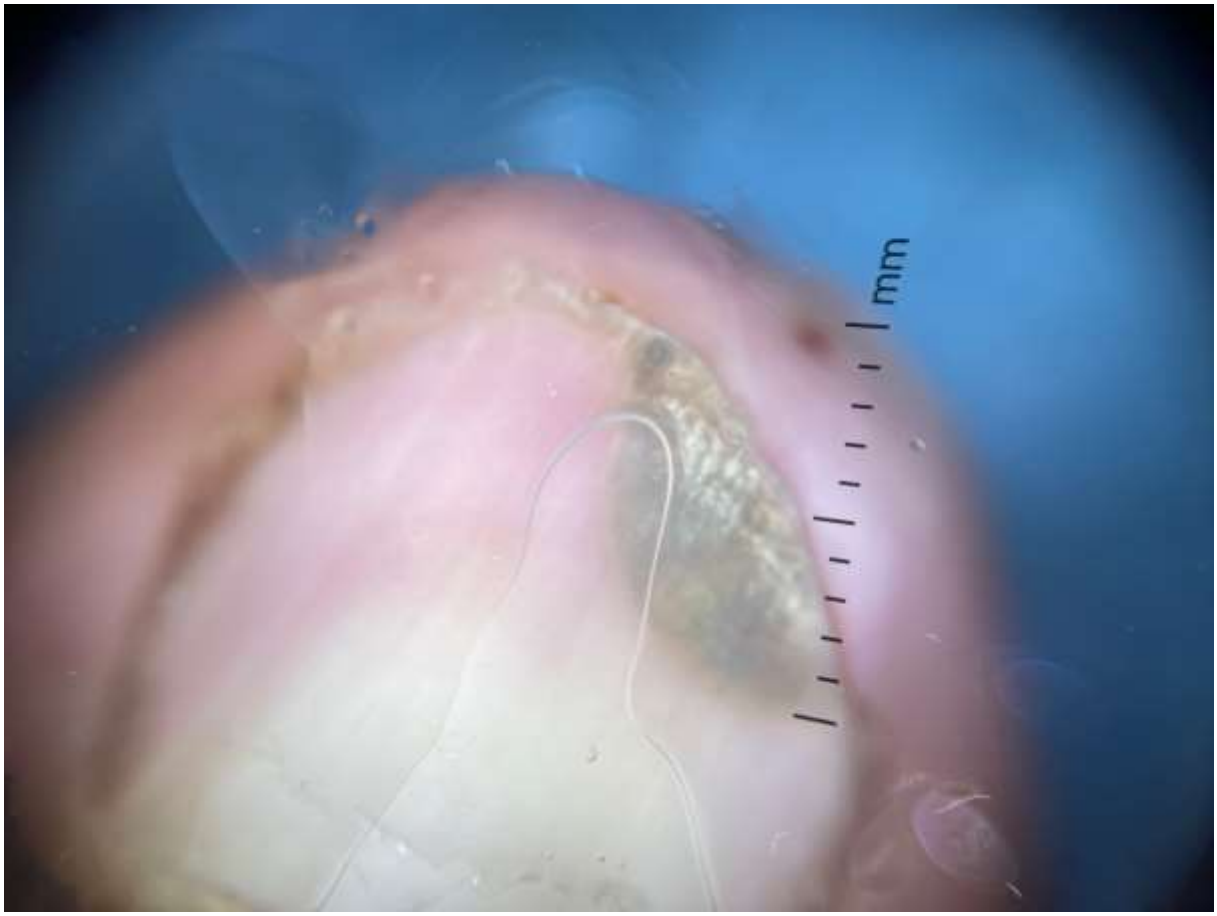

Figure 41 Non-specific melanonychia shape

d. Color:

The color of the melanonychia varied across the affected nails (Fig. 42). Gray-brown was the most common color (Fig. 43), present in 242 nails (44.2%), followed by light brown (Fig. 44) in 119 nails (21.7%). Gray melanonychia (Fig. 45) was observed in 83 nails (15.2%), while dark brown (Fig. 46) was seen in 76 nails (13.9%). Black melanonychia (Fig. 47) was present in 21 nails (3.8%), and a small proportion, 7 nails (1.3%), displayed multicolor melanonychia (Fig. 48).

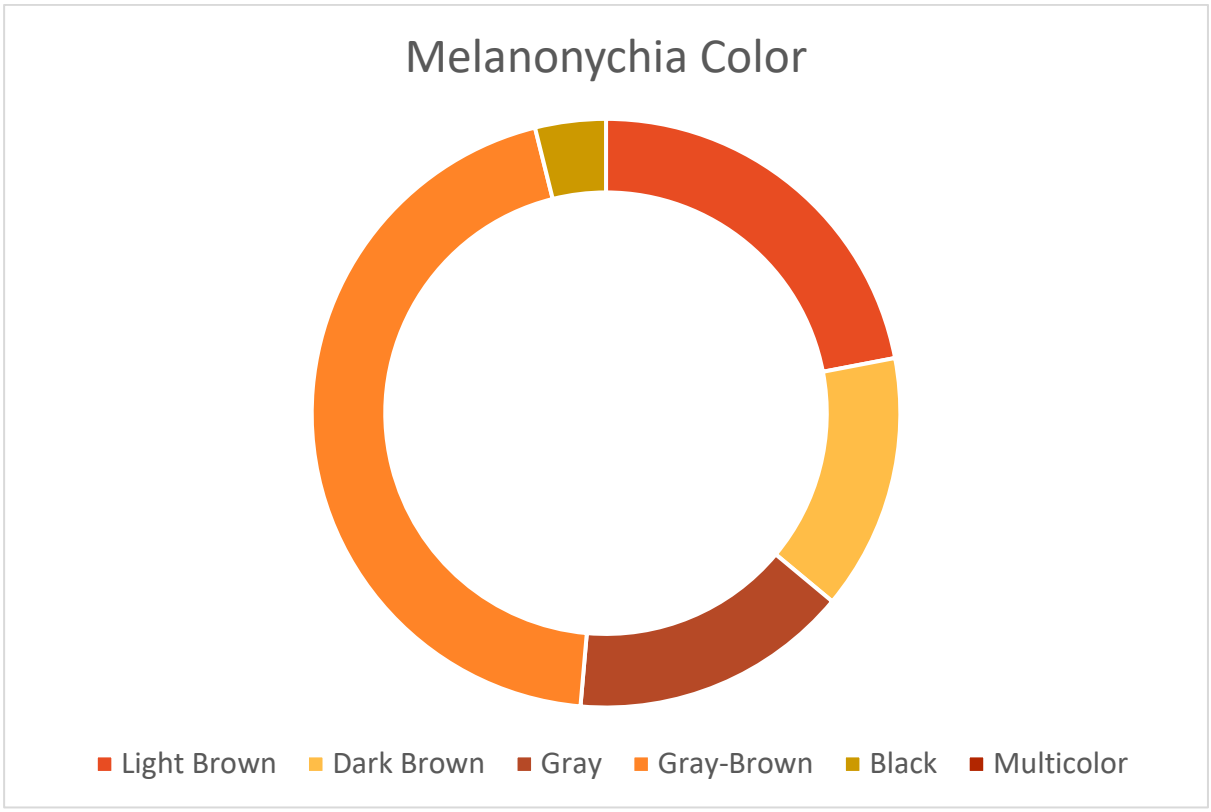

Figure 42 Distribution of melanonychia according to band color

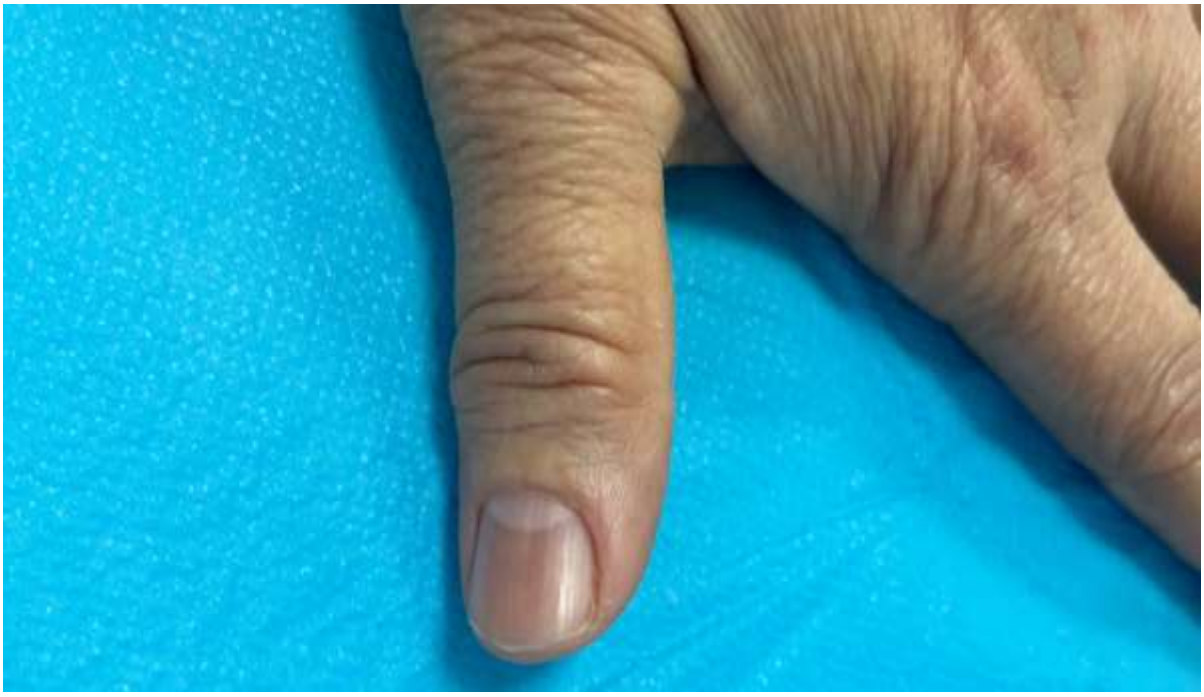

Figure 43 Grey-Brown melanonychia

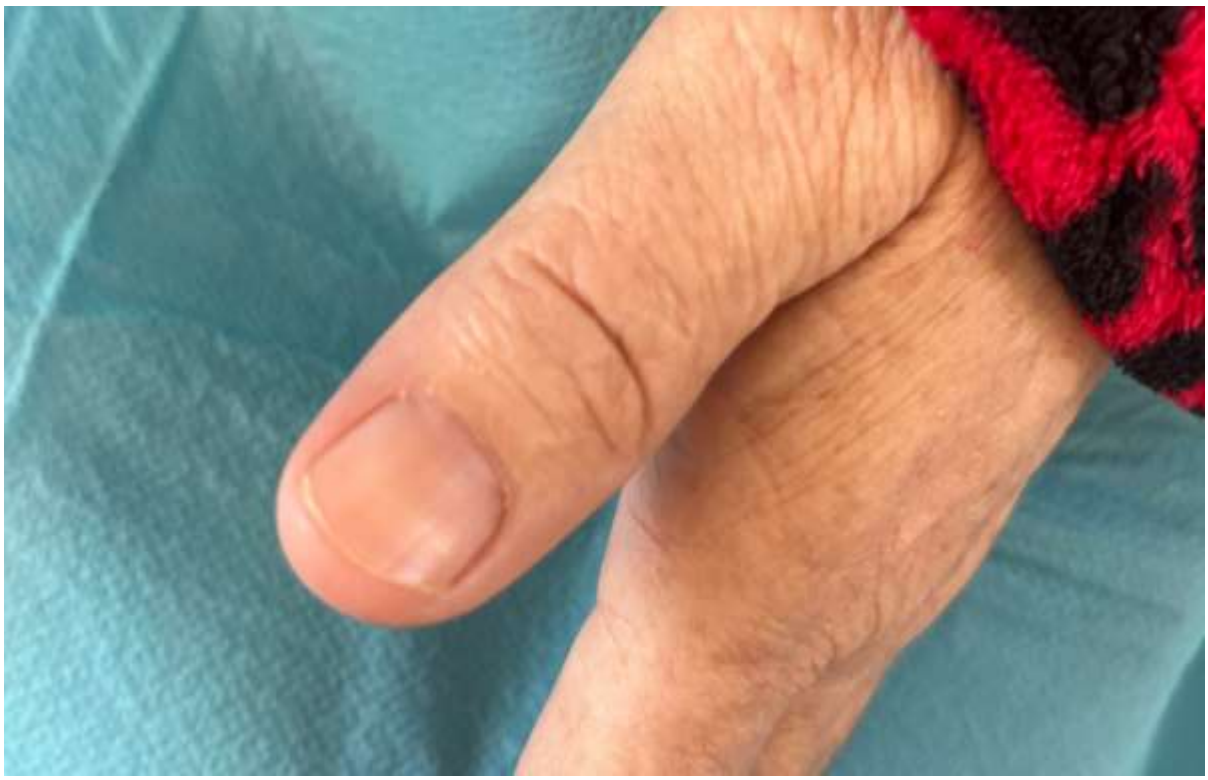

Figure 44 Light brown melanonychia

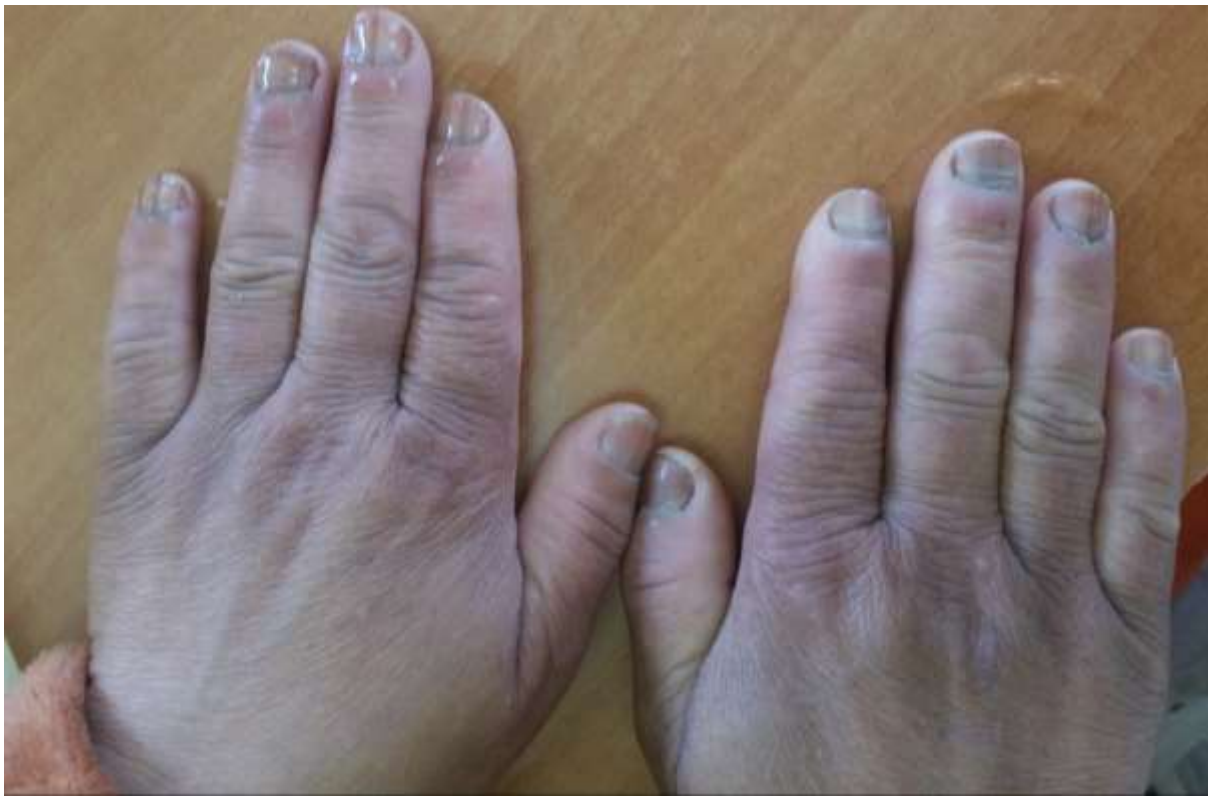

Figure 45 Gray melanonychia

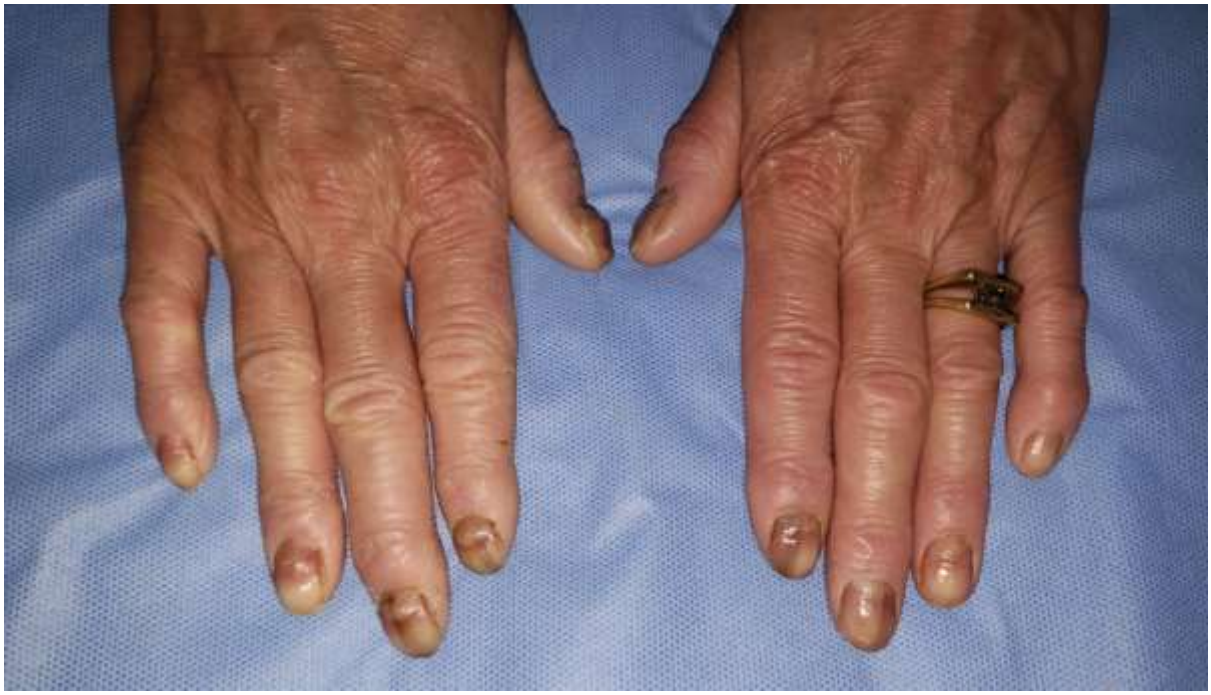

Figure 46 Dark brown melanonychia

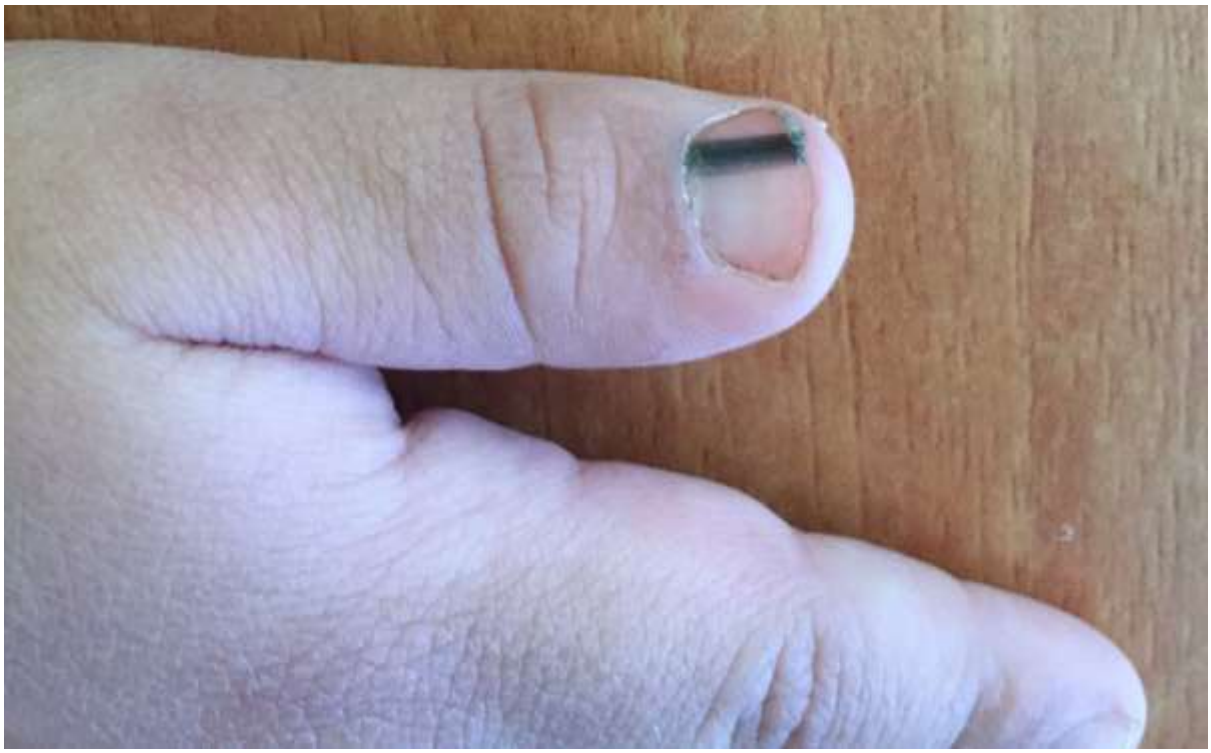

Figure 47 Black melanonychia

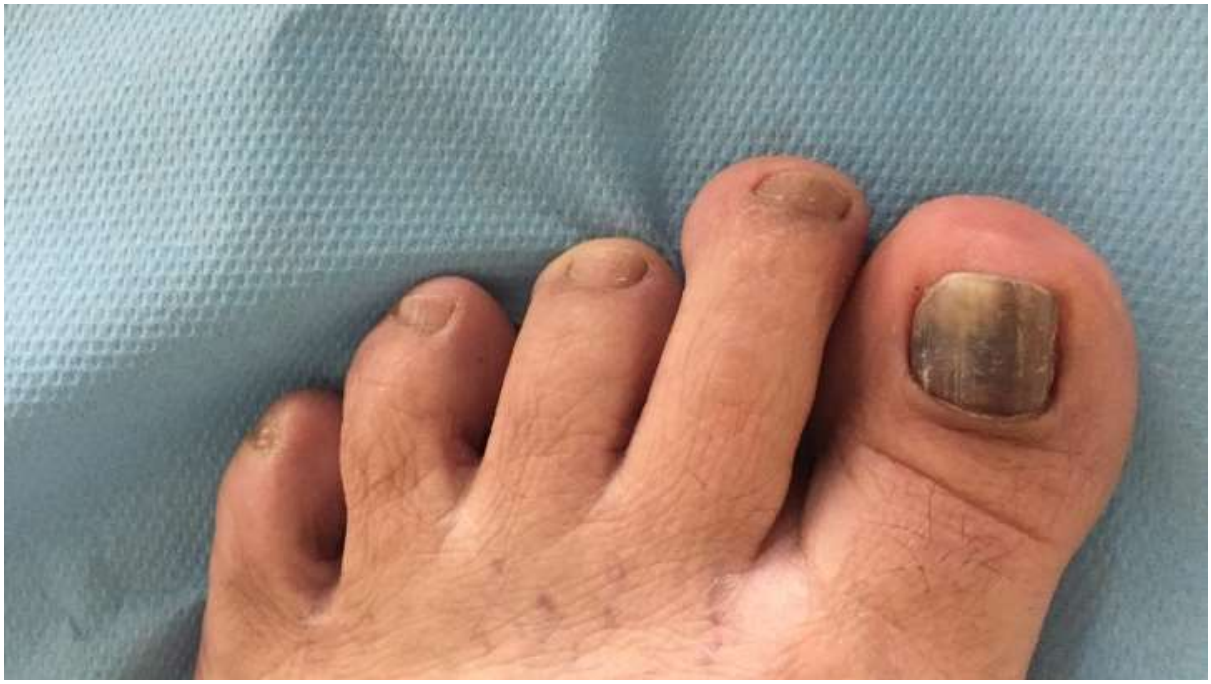

Figure 48 heterogenous melanonychia displaying multiple colors

e. Associated nail changes:

Several nail changes were observed in association with melanonychia (Fig. 49). The most common finding was distal onycholysis (Fig. 50,51), seen in 197 nails, followed by white or yellow streaks (Fig. 50,51), in 176 nails and nail surface scaling in 170 nails (Fig. 51). Pachyonychia (Fig. 52) was noted in 156 nails, while diffuse subungual hyperkeratosis was observed in 154 nails (Fig. 52).

Nail dystrophy was identified in 89 nails (Fig. 53), while splinter hemorrhages were noted in 58 nails (Fig. 53). Less frequently, localized subungual hyperkeratosis was present in 22 nails (Fig. 54). Dorsal pterygium and paronychia were rare, each seen in only 2 nails (Fig. 55). Nail hypercurvature was observed in 1 nail (Fig. 56).

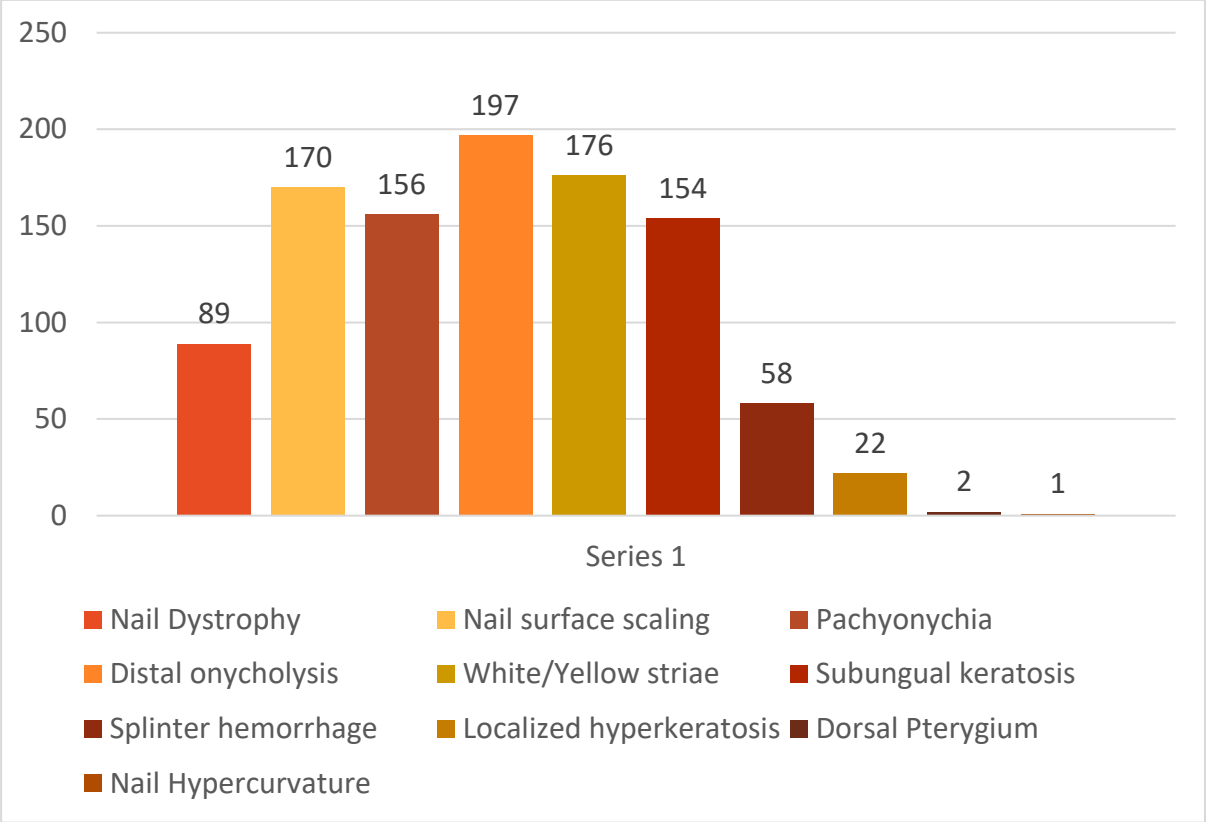

Figure 49 Distribution of associated nail changes

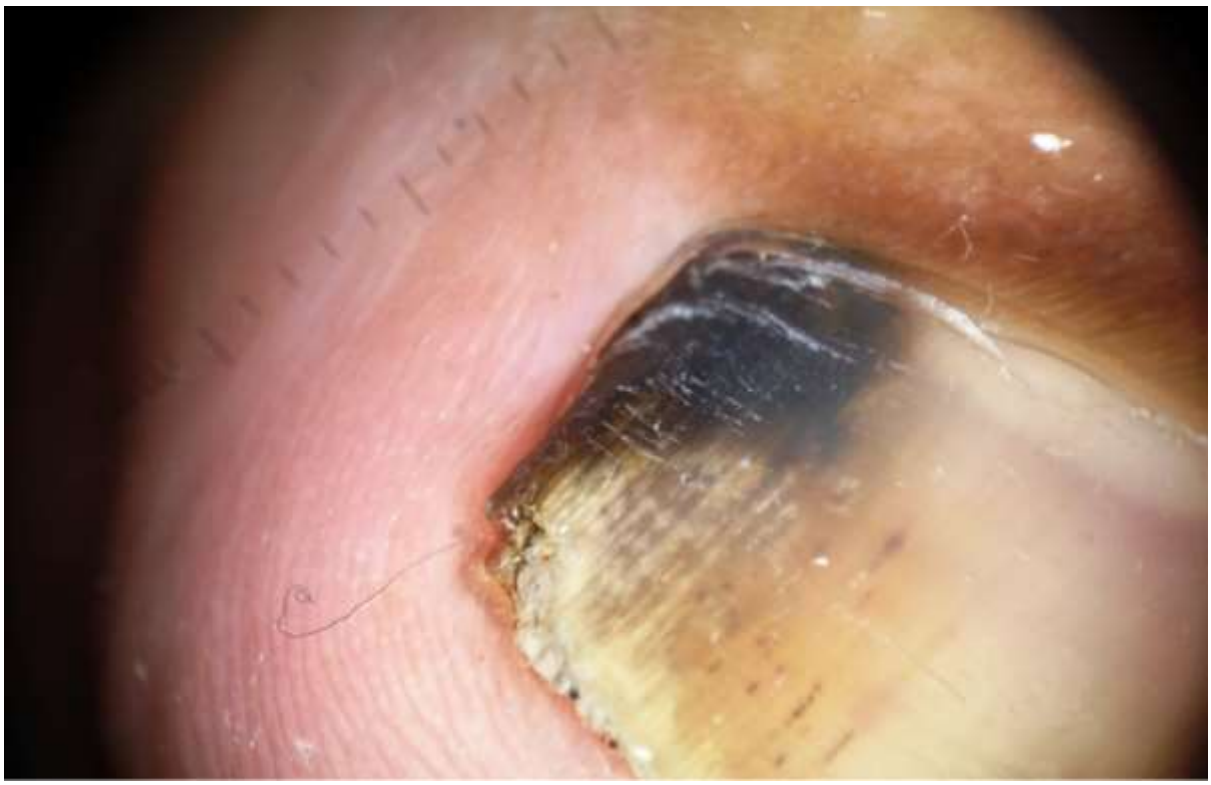

Figure 50 Onychomycosis melanonychia (T.rubrum), with distal onycholysis, splinter hemorrhage and yellow longitudinal striae

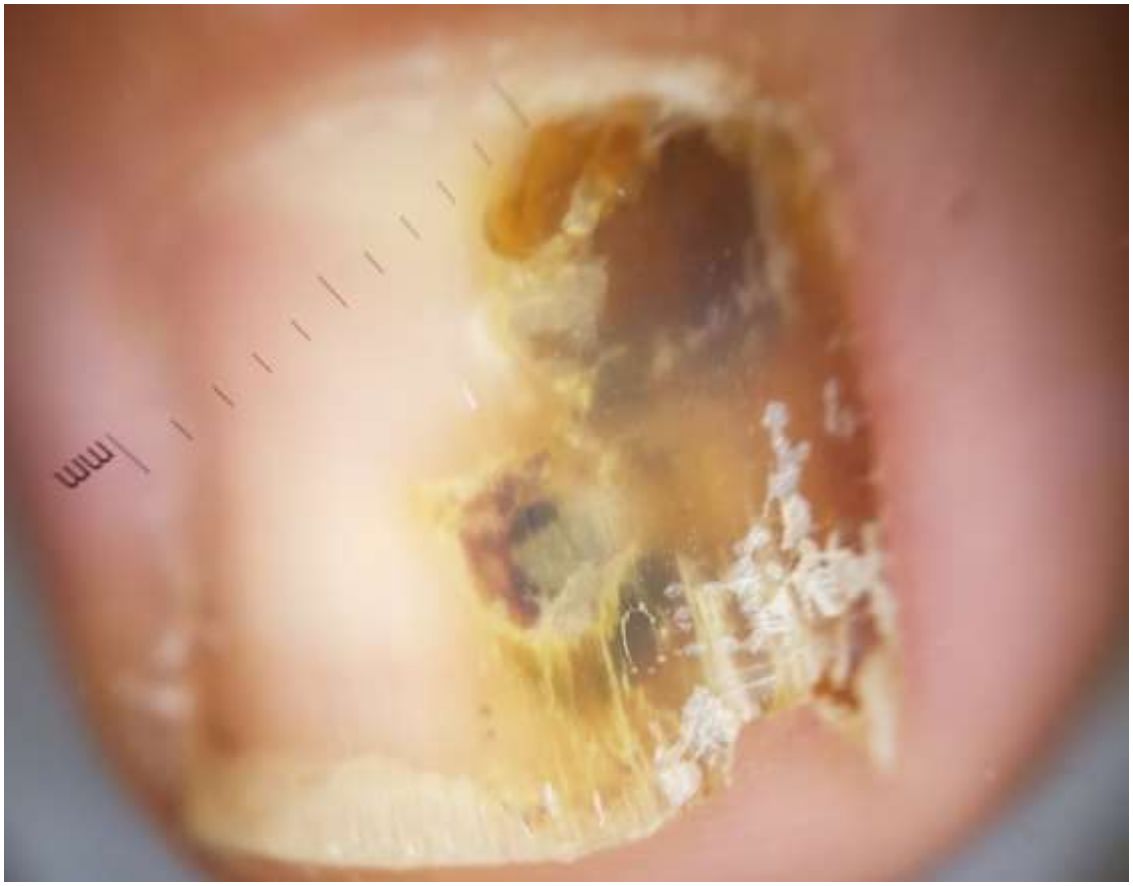

Figure 51 Subungual hemorrhage with T.rubrum superinfection. Dermoscopy shows brown-reddish hues, with rounded borders, associated todistal onycholisis, yellow streaks and nail surface scaling

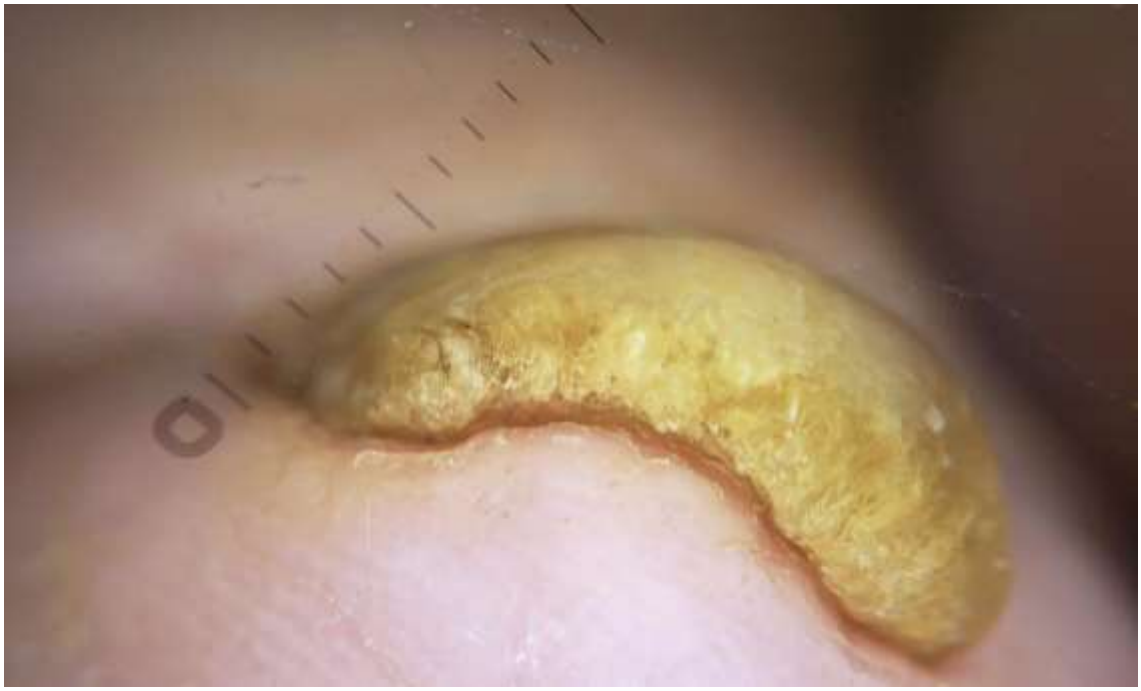

Figure 52 Nail edge dermoscopy showing pachyonychia associated with diffuse subungual keratosis.

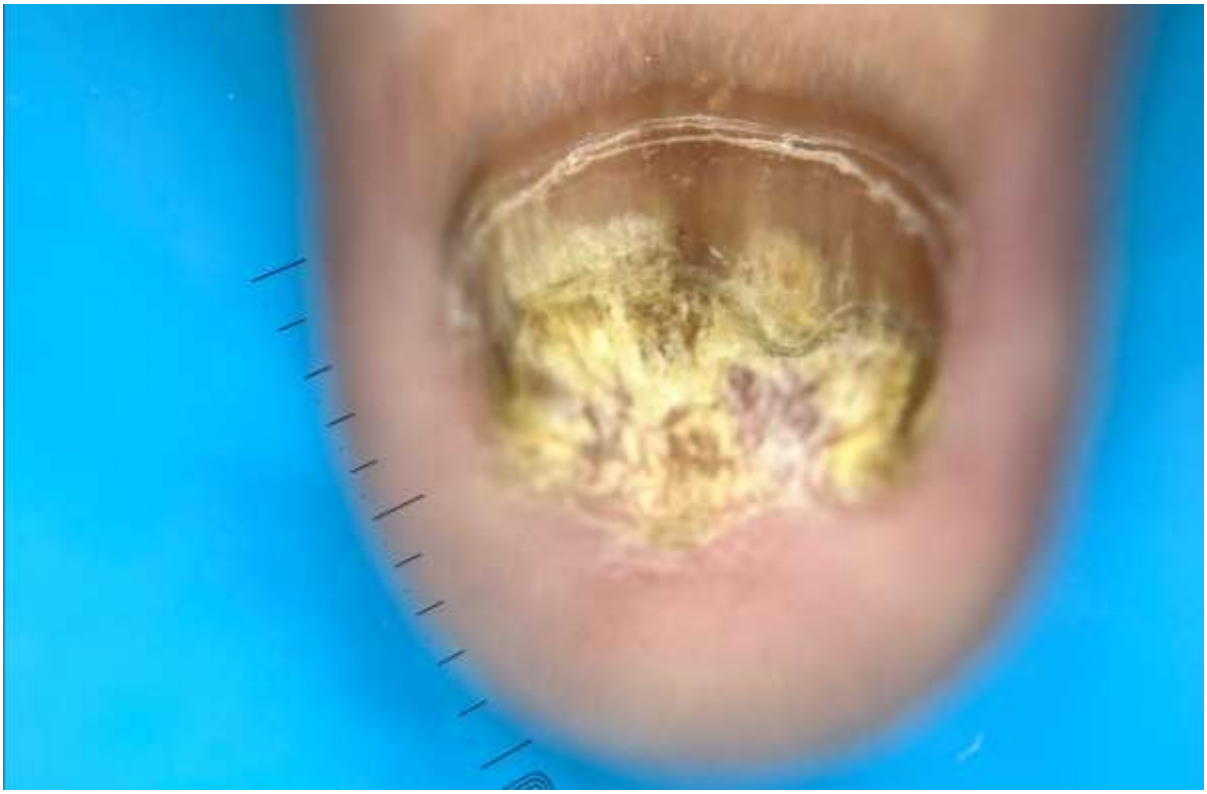

Figure 53 Nail dystrophy

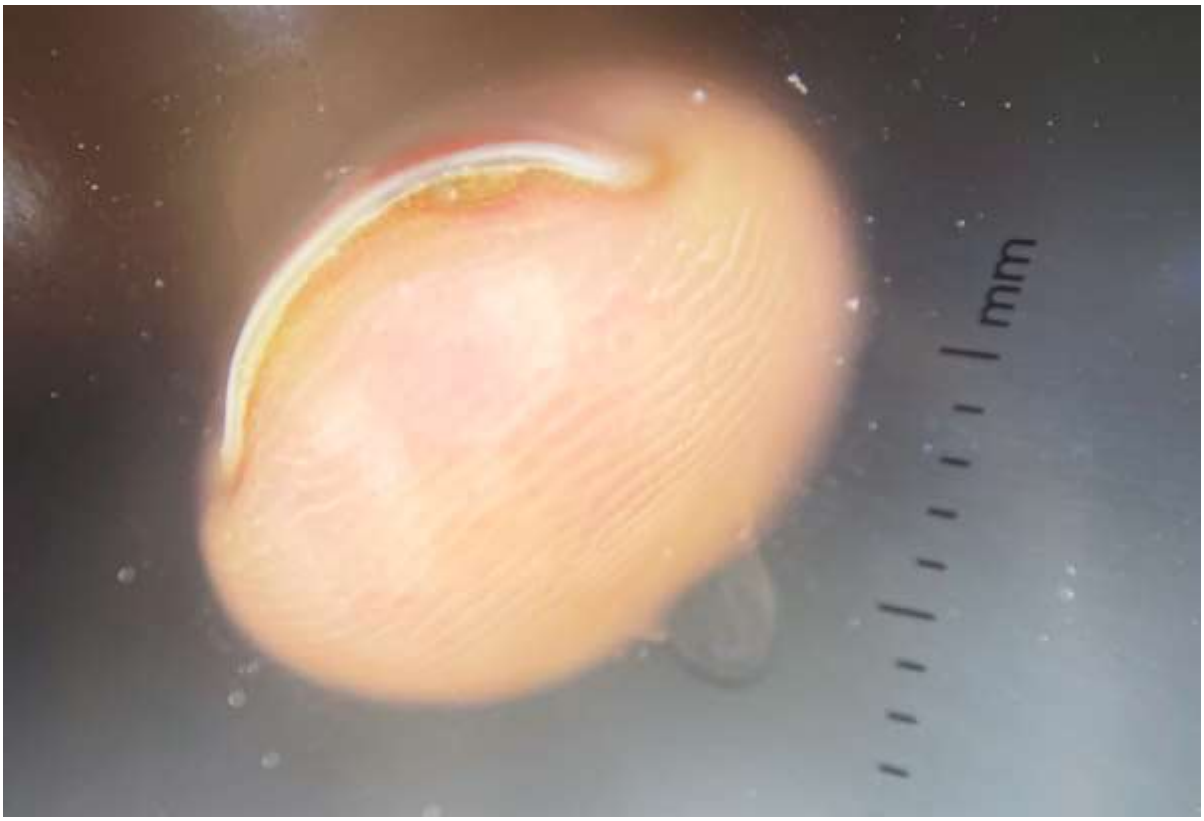

Figure 54 Localized subungual keratosis in a post-traumatic melanonychia.

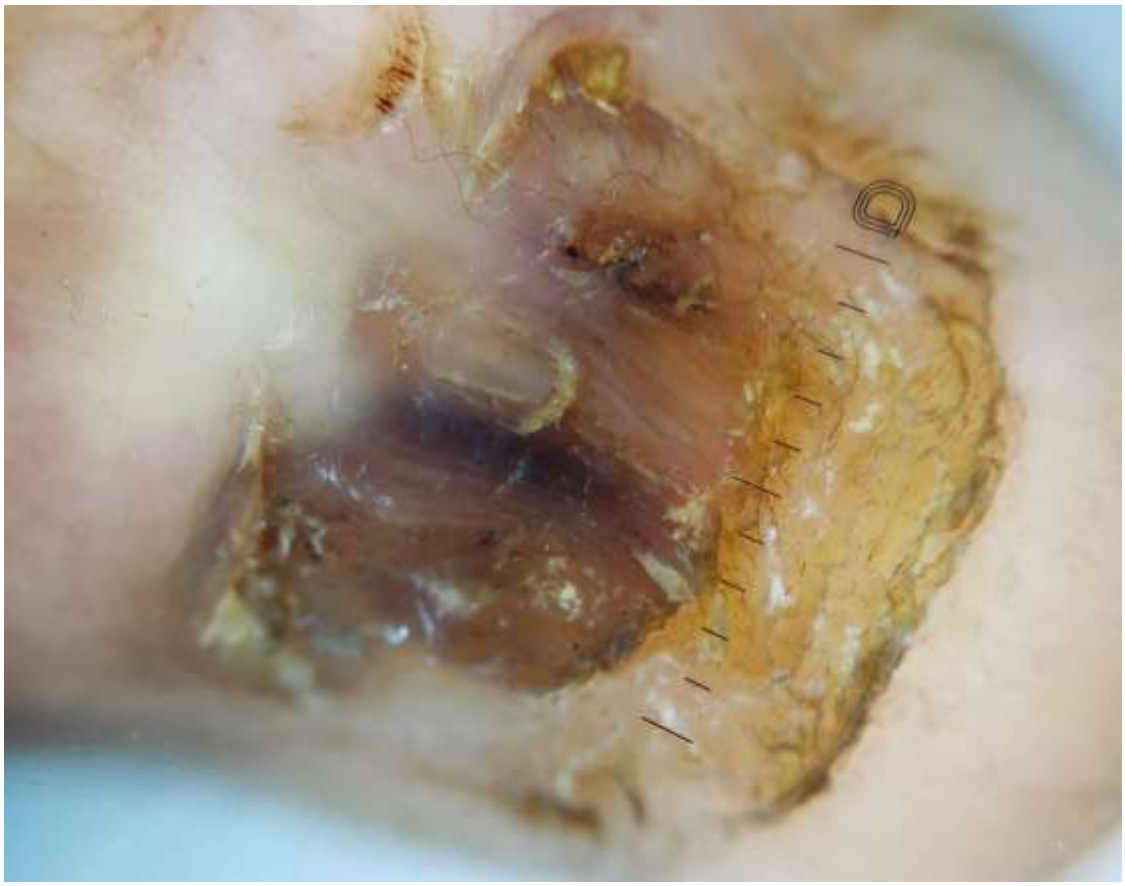

Figure 55 Dorsal Pterygium

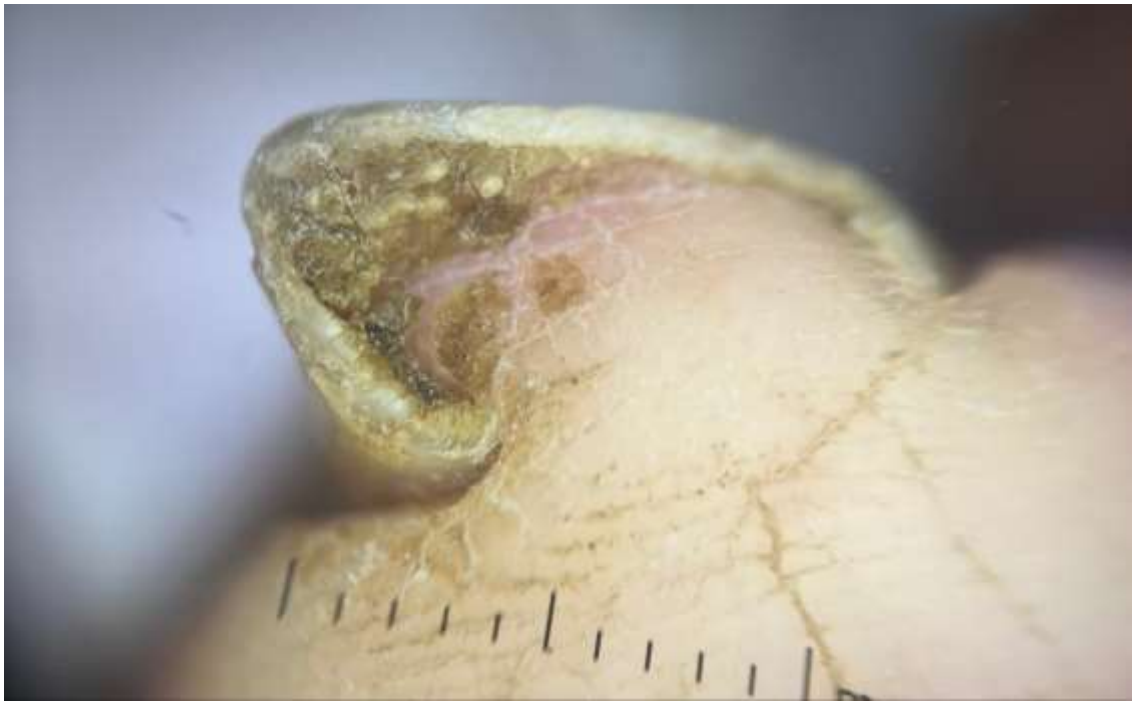

Figure 56 Nail Hypercurvature in an onychomatricoma

3. Dermoscopic Features:

a. Colors:

Under dermoscopic examination, the background color of melanonychia varied across the cohort. The most frequently observed background was gray, present in 340 nails (62.0%), followed by light brown in 137 nails (25.0%) and dark brown in 40 nails (7.3%). Less common hues included gray-blue in 11 nails, black in 3 nails, dark red in 1 nail, and multicolored backgrounds in 16 nails (Fig. 57).

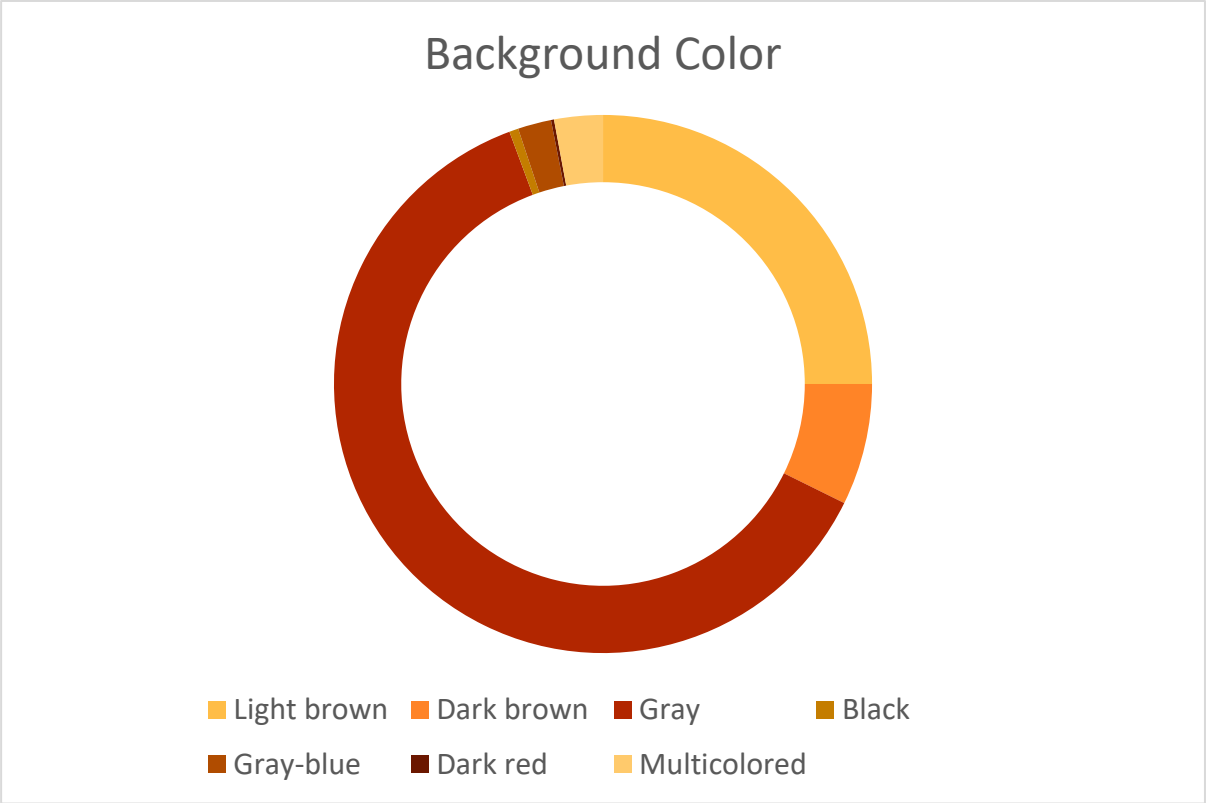

Figure 57 Distribution of melanonychia according to background color

The number of distinct pigmentation colors per nail was also recorded (Fig. 58): a single color was seen in 345 nails (63.0%), two colors in 157 nails

(28.6%), three colors in 31 nails (5.7%), four colors in 13 nails (2.4%), and five colors in only 2 nails (0.4%).

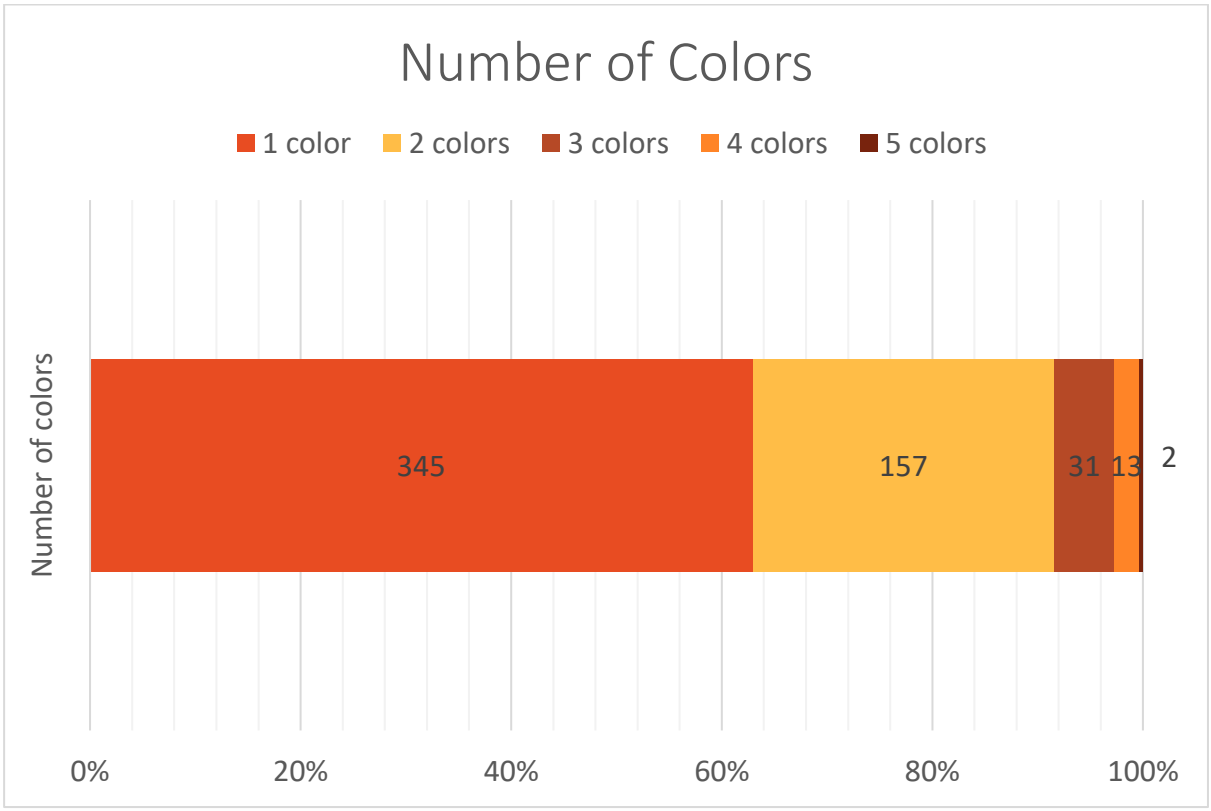

Figure 58 Distribution of melanonychia cases based on the number of colors observed within the pigmented bands.

Regarding the color of the dermoscopic lines specifically, gray lines were the most frequent (209 nails), followed by light brown (148 nails), dark brown (105 nails), black (16 nails), and gray blue (11 nails).

Interestingly, in 126 nails (23.0%), the pigmentation color under dermoscopy appeared lighter than what was perceived on clinical (naked eye) examination (Fig. 59).

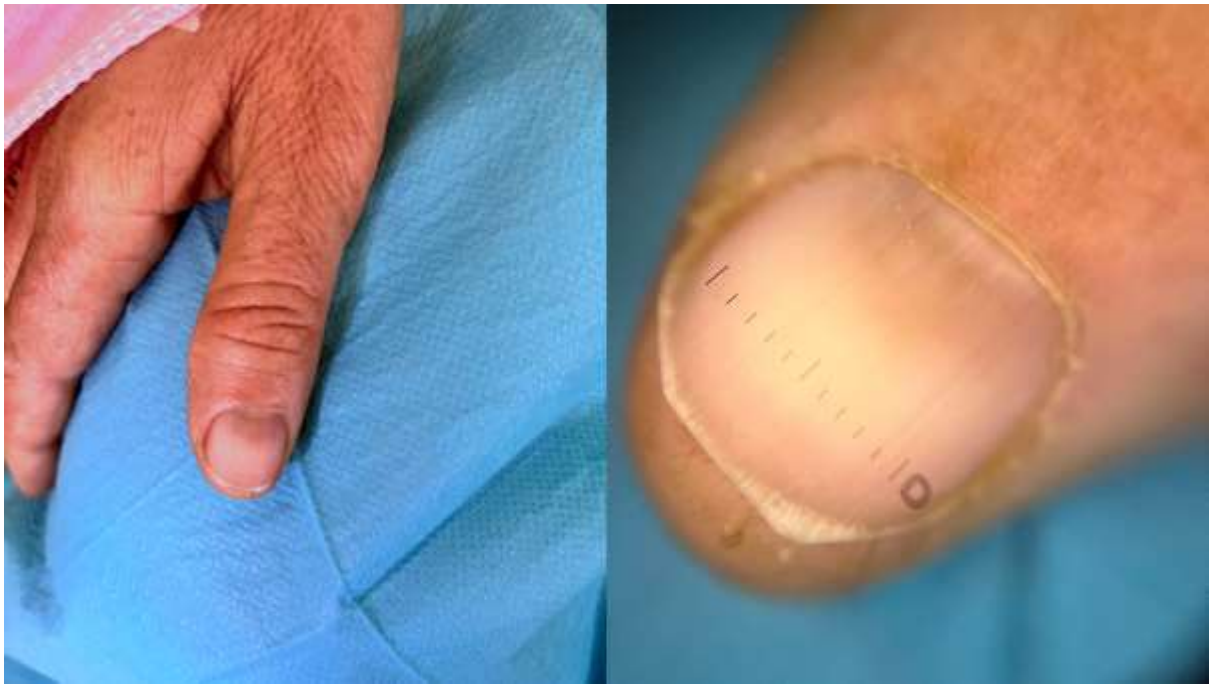

Figure 59 The melanonychia appears darker in the clinical image than the dermoscopic image

b. Pattern:

Dermoscopy of the 548 nails with melanonychia revealed a predominant homogeneous pigmentation pattern without discernible lines in 238 nails (43.4%) (Fig. 60). A longitudinal pattern, characterized by parallel pigmented lines running along the axis of nail growth, was observed in 294 nails (53.6%), representing the most frequent structured pattern (Fig. 61). Less commonly, transverse pigmented lines were seen in 4 nails (0.7%) (Fig. 62), while granular pigmentation (Fig. 63), consisting of irregular fine dots or speckles of pigment, was noted in 7 nails (1.3%).

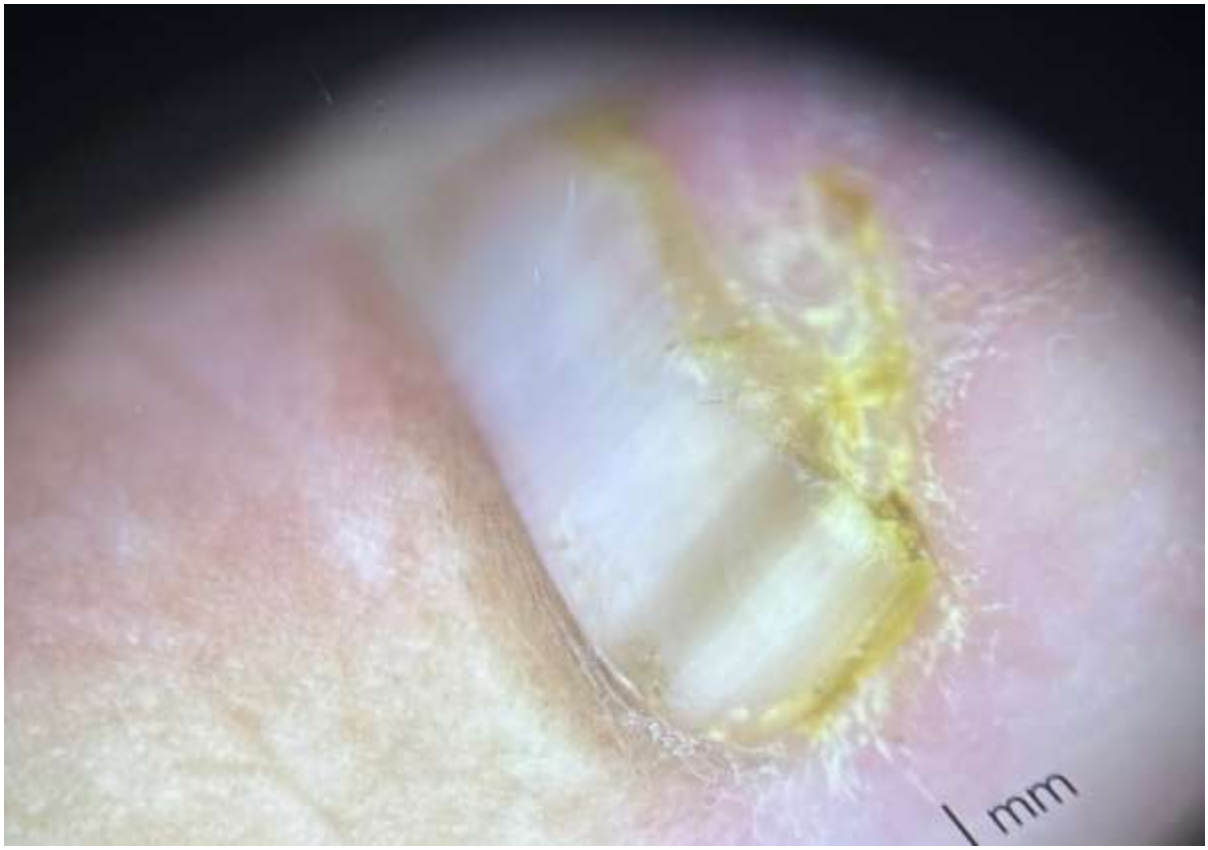

Figure 60 Homogenous pattern without discernible lines

Figure 61 Longitudinal line pattern

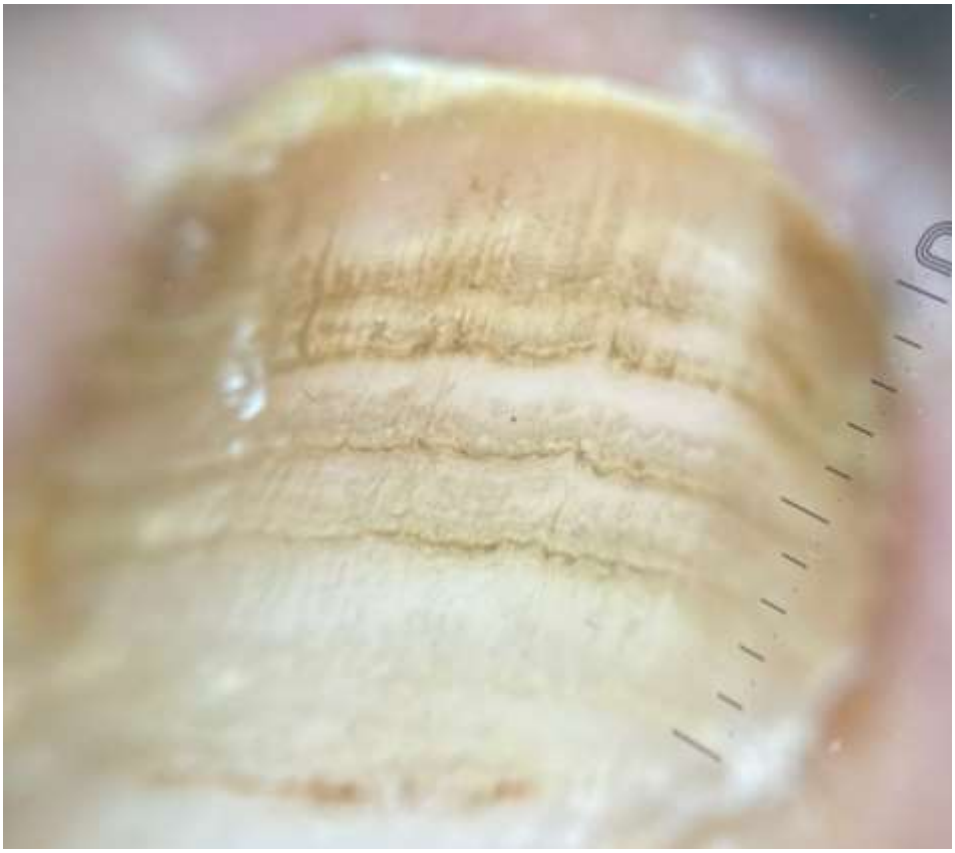

Figure 62 Dermoscopic image of the toenail showing longitudinal fissuring (onychoschizia/onychorrhexis) with brown-yellow exogenous pigment deposition, consistent with chronic trauma.

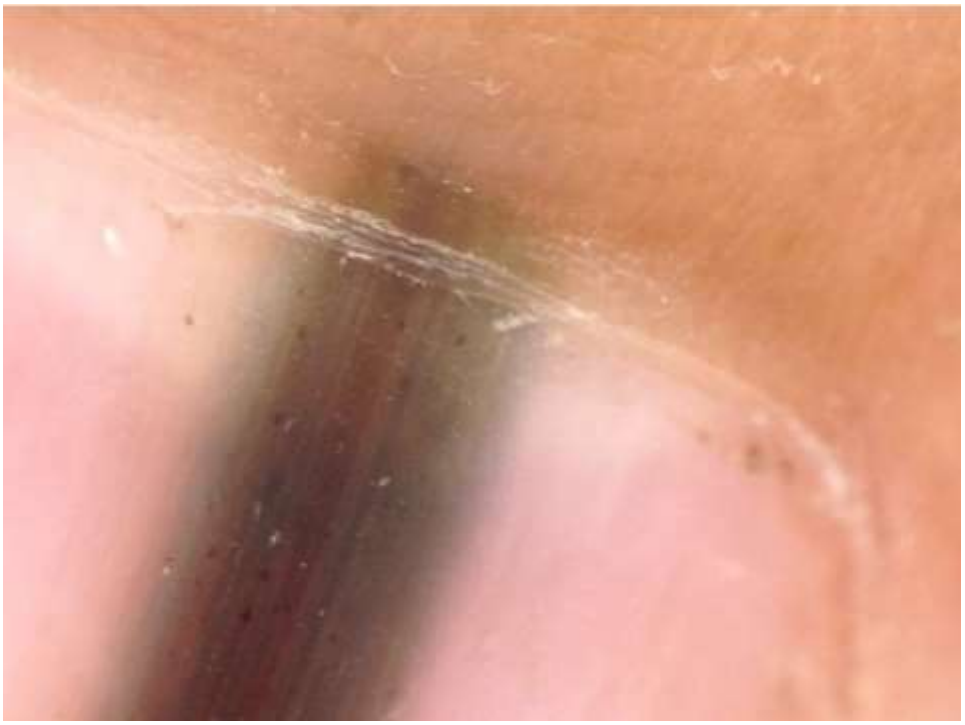

Figure 63 pigmented granules are irregularly distributed.

Among the cases of longitudinal lines, atypical features were occasionally observed. Loss of parallelism between lines was documented in 8 cases, irregular thickness of the pigmented lines in 55 nails, and irregular spacing between lines in 56 nails (Fig. 64).

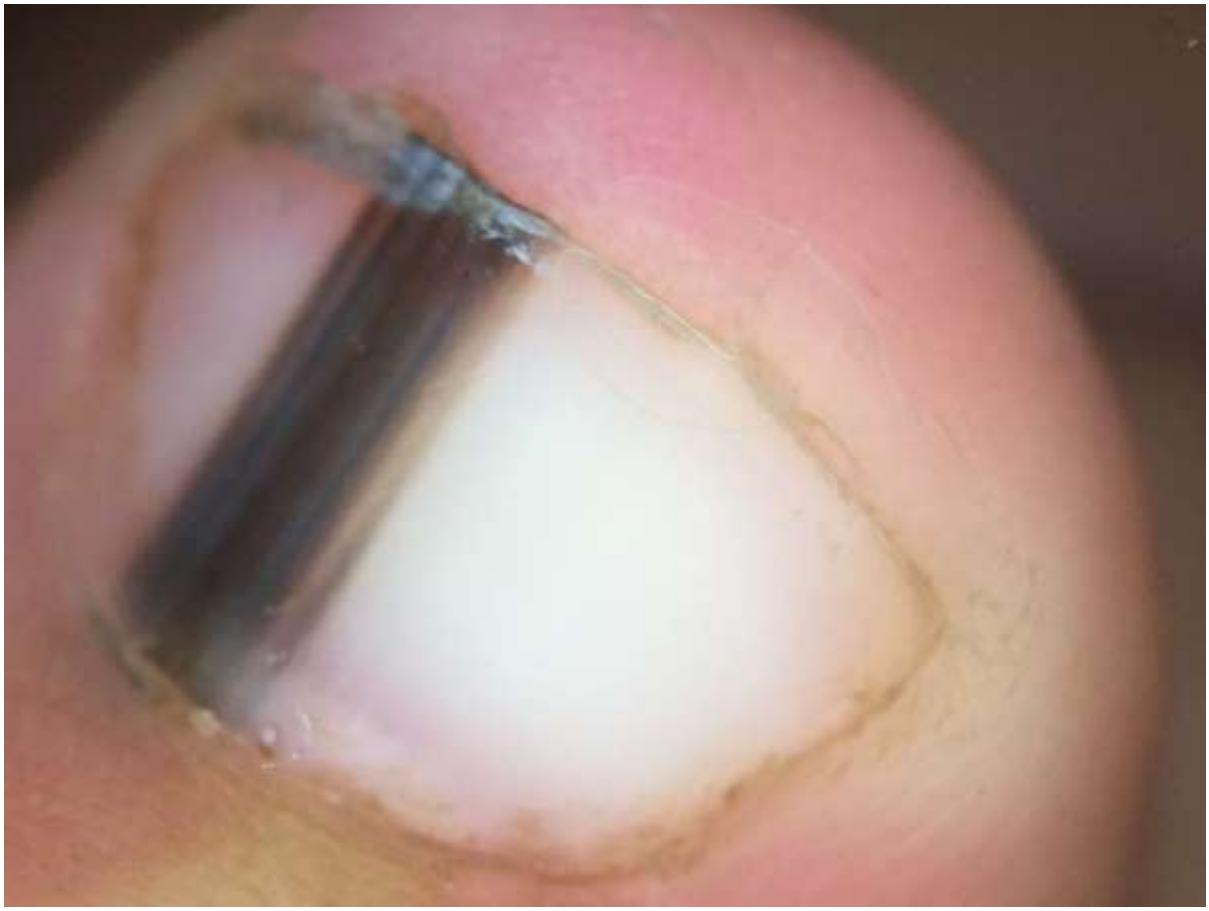

Figure 64 irregular spacing and line thickness, with a focal loss of parallelism in a congenital nevus

c. Free Edge Dermoscopy:

Examination of the free edge provided additional insights into the depth and distribution of pigmentation (Fig. 65). In 258 nails (47.1%), pigmentation was observed predominantly in the lower part of the free edge (Fig. 66), whereas upper part involvement was less frequent (Fig. 67), seen in only 17 nails (3.1%). Diffuse pigmentation across the entire thickness of the nail plate

was noted in 40 nails (7.3%) (Fig. 68). In contrast, no pigmentation of the free edge was observed in 208 nails (38.0%). Additionally, in 25 nails (4.6%), pigmentation was located beneath the nail plate (Fig. 69).

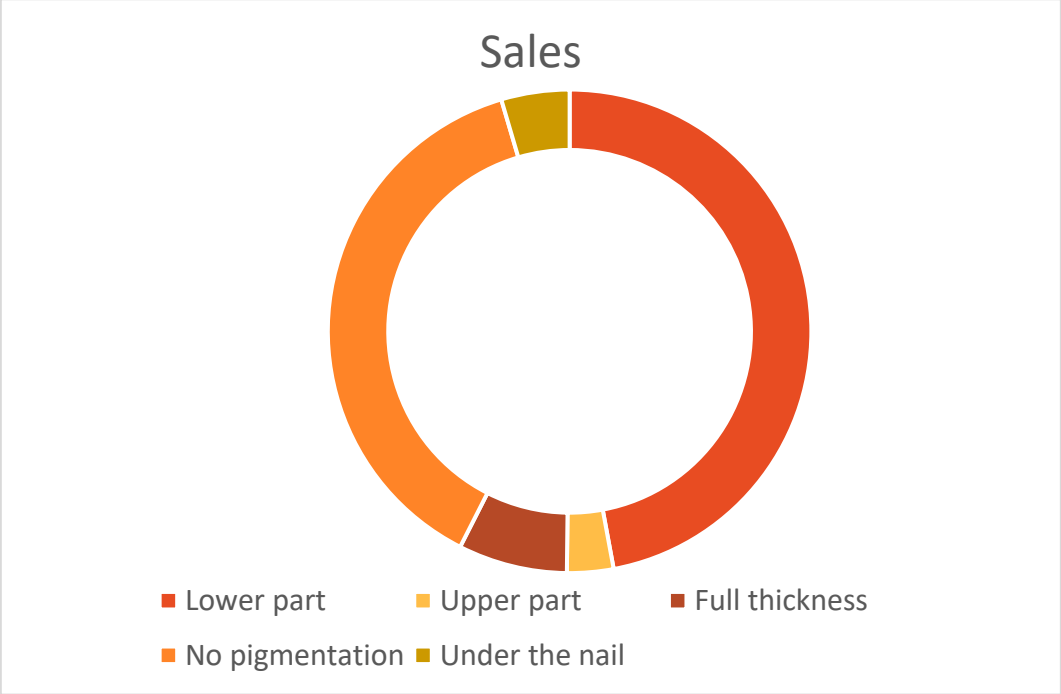

Figure 65 Dermoscopic view of pigment distribution along the free edge of the nail plate.

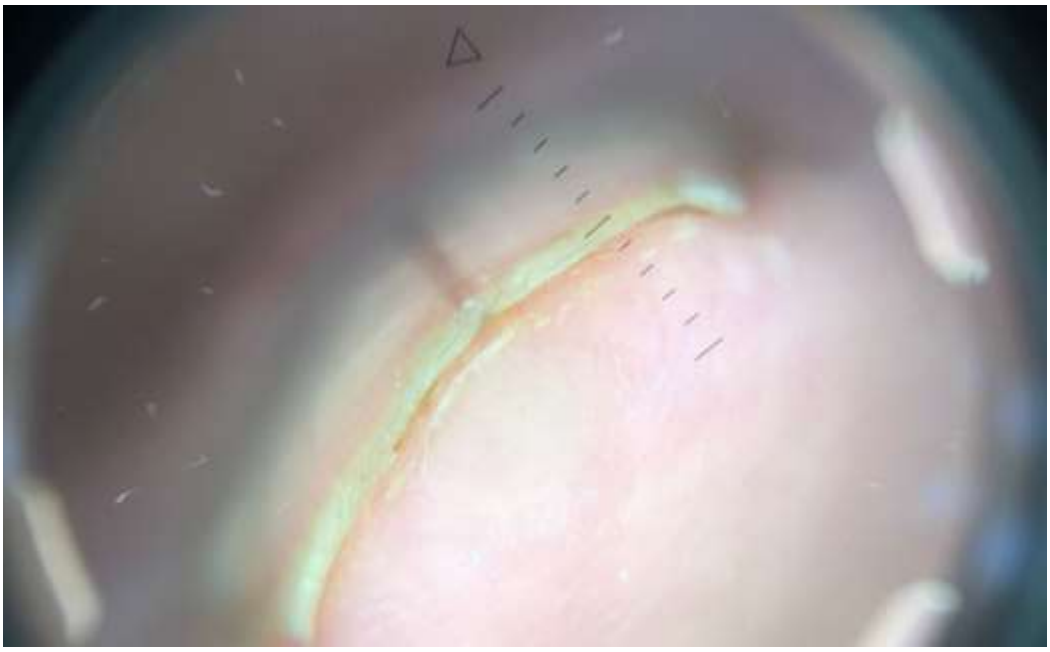

Figure 66 Free-edge dermoscopy showing pigmentation involving the lower portion of the nail plate.

Figure 67 Free-edge dermoscopy showing pigmentation involving the upper portion of the nail plate.

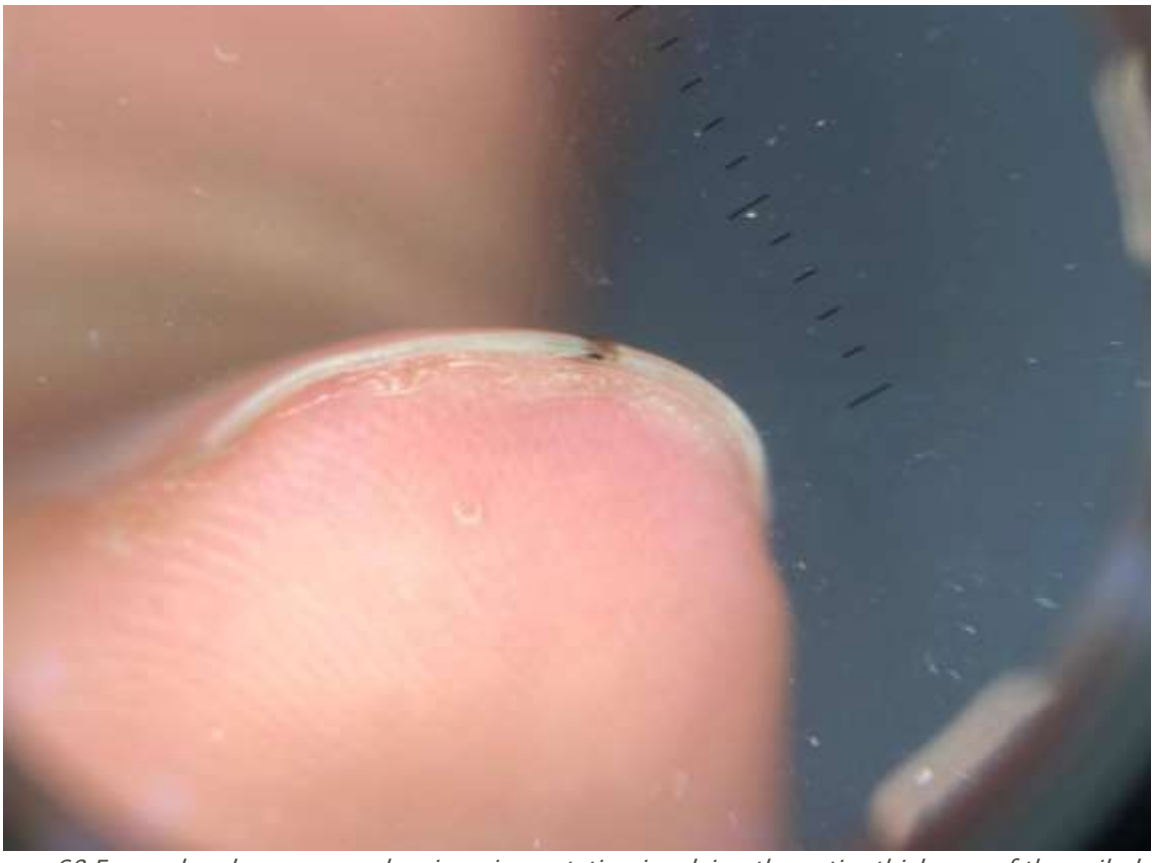

Figure 68 Free-edge dermoscopy showing pigmentation involving the entire thickness of the nail plate.

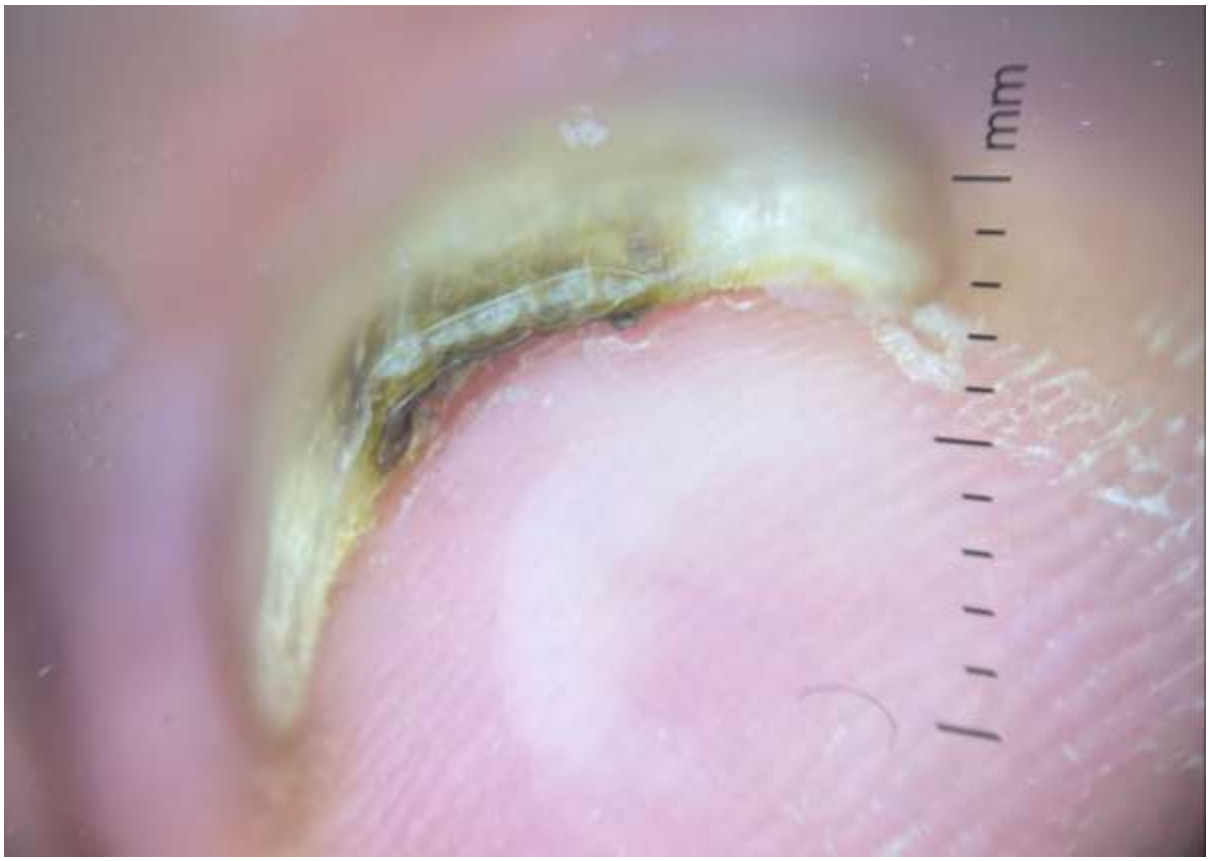

Figure 69 Free-edge dermoscopy showing pigmentation under the nail plate.

d. Nail Fold and Periungual Dermoscopic Findings

Periungual pigmentation was assessed through the presence of Hutchinson's sign and its variants. Hutchinson's sign was observed in 23 nails (4.2%). Pseudo-Hutchinson's sign was noted in 114 nails (20.8%). A micro-Hutchinson's sign was identified in 13 nails (2.4%).

In addition, involvement of the lateral nail folds or the hyponychium was seen in 7 nails (1.3%), all of which displayed a parallel ridge pattern on dermoscopy.

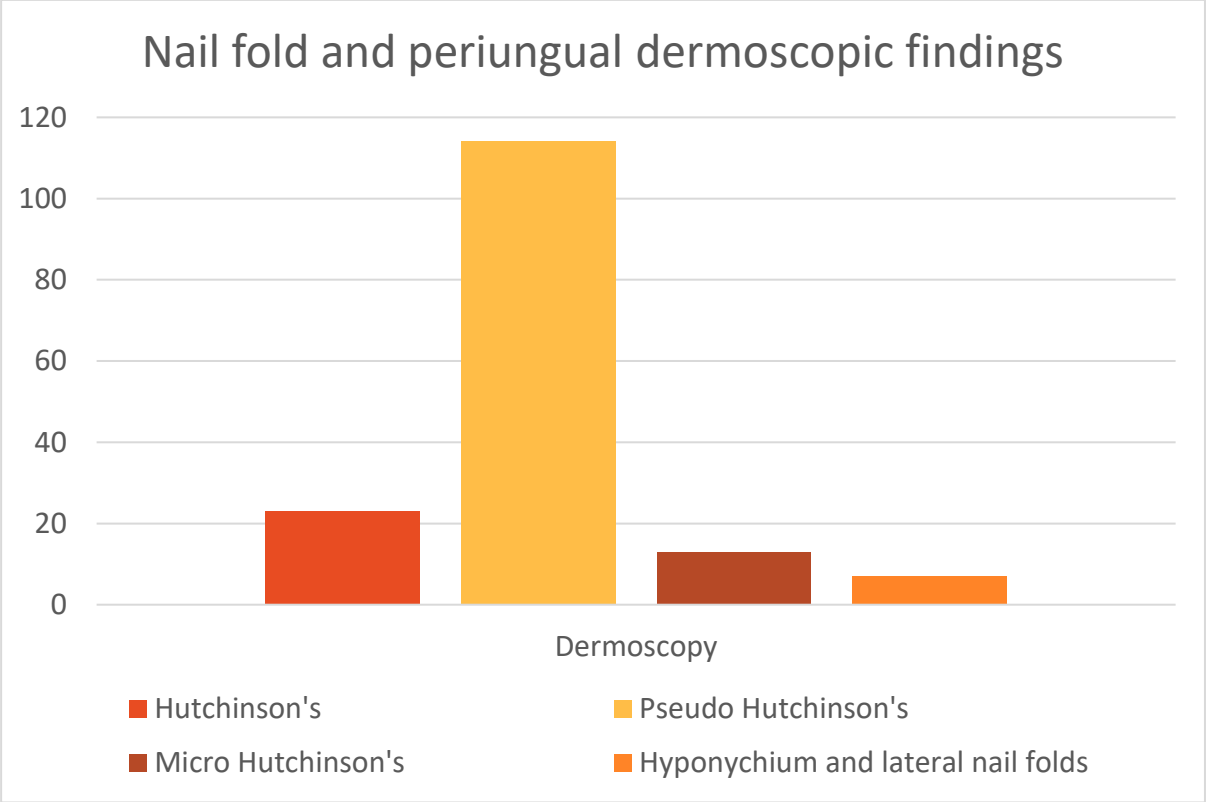

Figure 70 Distribution of dermoscopic findings in the nail folds and periungual area

4. Diagnostic Procedures:

In this study, the etiological investigation of melanonychia was supported by histological and mycological examinations when clinically indicated. Biopsies were performed in 22 lesions (Fig. 71). The primary indication was a suspicion of subungual melanoma in 12 cases. In 7 cases, biopsies were conducted for diagnostic clarification or excision of suspected benign tumors, while 3 cases involved other potential causes. Mycological sampling using potassium hydroxide (KOH) preparation was carried out in 58 patients, encompassing 188 nails (Fig. 72).

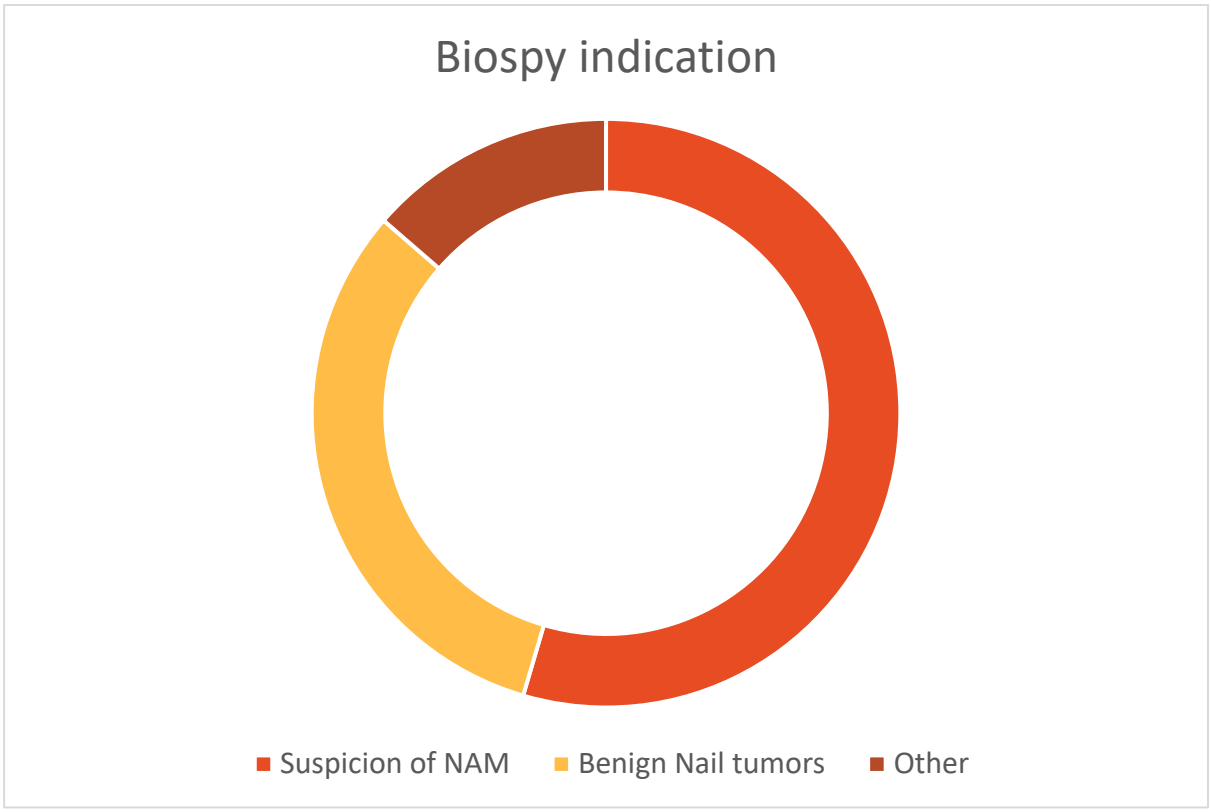

Figure 71 Biospy indications

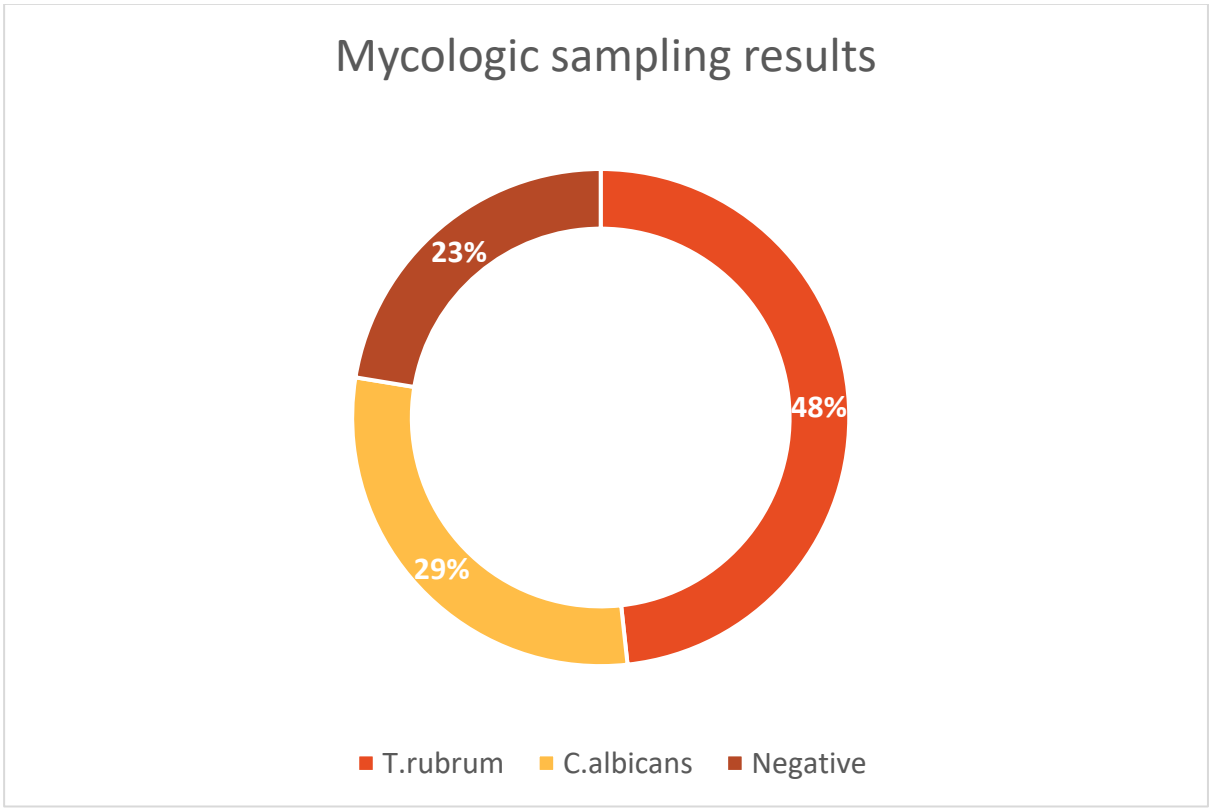

Figure 72 Mycological sampling

5. Etiologies and Etiology-Based Profiles of Melanonychia

A wide variety of underlying causes were identified.

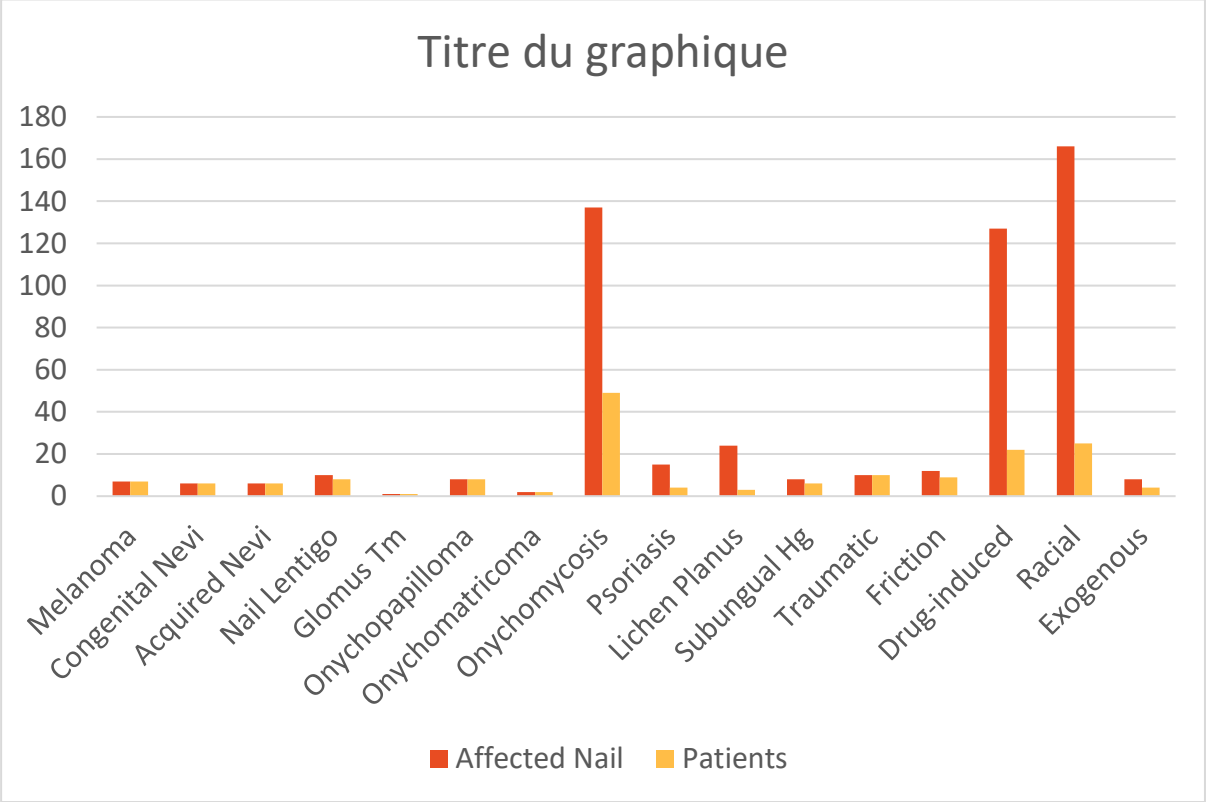

Figure 73 Distribution of etiologies

a. Melanocytic Activation

- Racial or Ethnic Pigmentation

Racial or ethnic melanonychia was the most frequent etiology (Fig. 74), affecting 166 nails (30.3%). It exclusively presented as polydactylic longitudinal melanonychia (100%), with all nails involved in 56% of patients and multiple bands per nail observed in 53% of cases. The pigmentation was typically gray-brown (46.4%) or gray (19.9%), with dermoscopy revealing a

homogeneous gray background in 84.9% of nails and gray or light brown lines in 53% and 35.5% of cases, respectively. Hutchinson's sign was absent in all cases, while pseudo-Hutchinson's sign was noted in 16.3% of nails. The phototypes observed in this group were: III (16%), IV (52%), V (12%), and VI (20%).

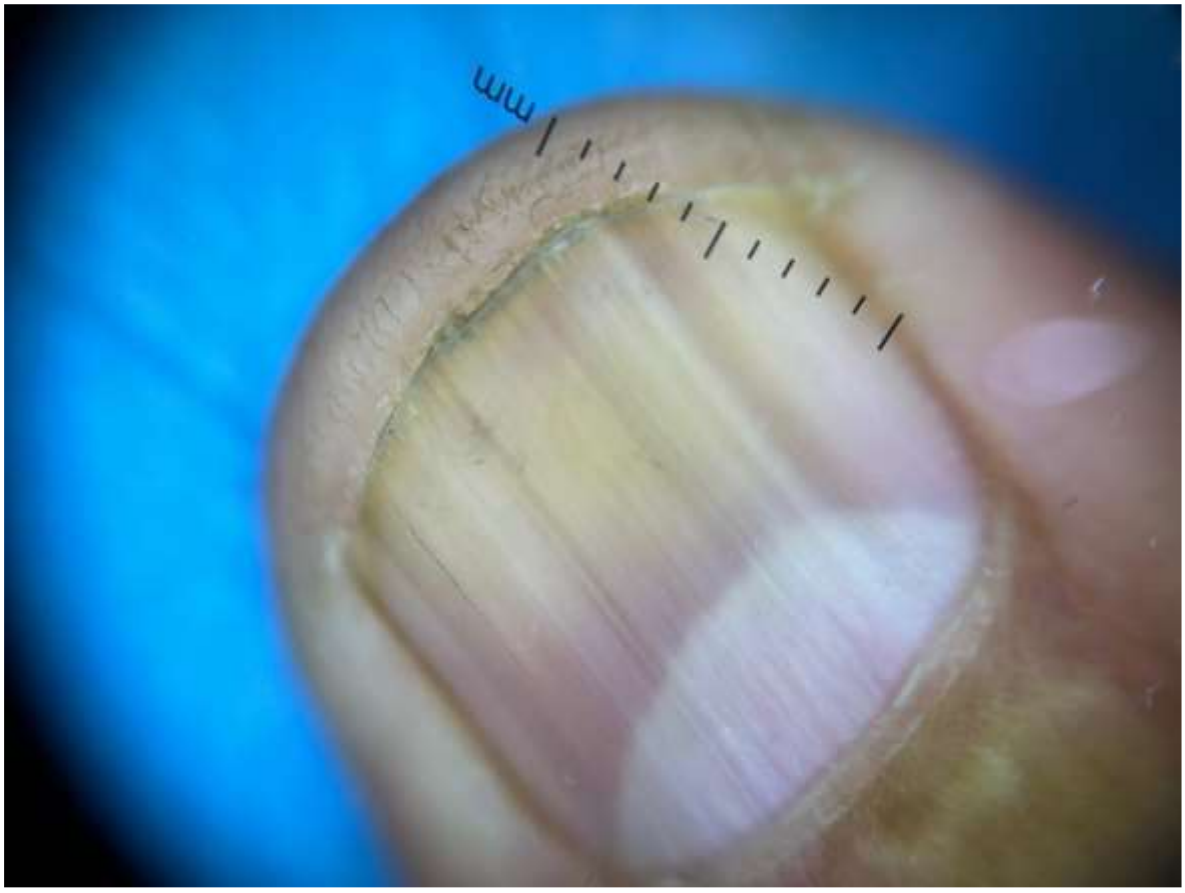

Figure 74 Ethnic melanonychia presenting as multiple longitudinal bands on a single nail, with a gray background and regular gray lines on dermoscopy.

- Drug-Induced Pigmentation

Drug-induced melanonychia was identified in 22 patients, involving a total of 127 nails (23.7%). This form consistently presented with polydactylic involvement, with all nails affected in 45.5% of cases. Multiple melanonychia bands per nail were observed in 60.6%, while the patterns included longitudinal

melanonychia in 67.7%, transverse melanonychia in 28.3%, and total melanonychia in 3.9%. A discrepancy between the clinical and dermoscopic color was noted in 36.2% of nails. The most frequent pigmentation colors were gray-brown (55.9%), gray (22.8%), and dark brown (4.7%). Dermoscopy revealed a homogeneous background without visible lines in 73.2% of cases, while a regular parallel pattern was present in 26.8% (Fig. 75).

The drugs implicated in our sample were predominantly chemotherapeutic agents. Paclitaxel was the most frequently involved (4 cases), followed by docetaxel (2 cases) and cisplatin (2 cases). Several combination regimens were also identified, including paclitaxel with doxorubicin and cyclophosphamide (4 cases); doxorubicin, cyclophosphamide, and docetaxel (1 case); doxorubicin and cyclophosphamide (1 case); paclitaxel with docetaxel (1 case); and a combination of carboplatin, doxorubicin, cyclophosphamide, and paclitaxel (1 case). One patient had received a regimen combining bevacizumab, oxaliplatin, and fluorouracil.

In addition to chemotherapy, other drugs associated with melanonychia in our cohort included chloroquine (2 cases), highly active antiretroviral therapy (HAART; 2 cases), and isotretinoin (1 case).

Figure 75 Transverse melanonychia in a patient undergoing cisplatin therapy, characterized by alternating gray and non-pigmented bands arranged parallel to the lunula.

- Post-Inflammatory Melanonychia

This subtype, comprising cases associated with lichen planus and psoriasis, involved 39 nails (7.1%). Nail involvement was predominantly polydactylic (82.1%), with pigmentation most often light brown or gray. Dermoscopic patterns were either homogeneous or longitudinal, with subtle irregularities in line spacing or parallelism observed in 35.9% of cases. Granular pigmentation was noted in one patient.

Associated nail findings included distal onycholysis (82%), subungual hyperkeratosis (74.4%), pachyonychia (66.7%), surface scaling (30.7%), and

white streaks or leukonychia (79.4%). Dorsal pterygium was observed in two cases of lichen planus (Fig. 76). Mycological sampling using KOH preparation was performed in all patients to rule out concomitant onychomycosis.

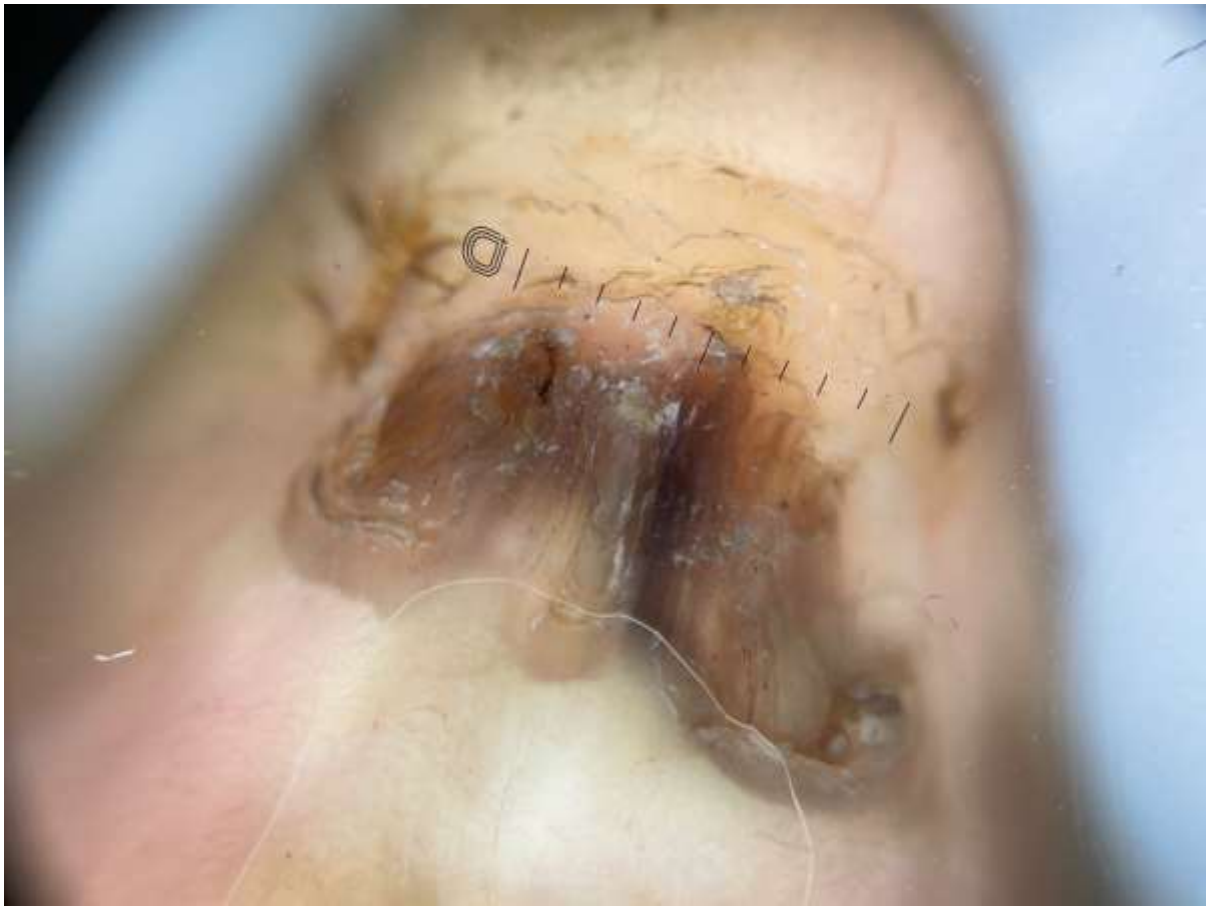

Figure 76 Lichen planus-associated nail involvement presenting with homogeneous black longitudinal melanonychia overlying a background of total brown melanonychia. Additional findings include dorsal pterygium, nail plate dystrophy, surface scaling, and pseudo-Hutchinson's sign.

- Frictional Melanonychia

Friction-related melanonychia was identified in 12 nails (2.4%), most commonly presenting as monodactylic involvement (77.8%). The majority of cases exhibited a regular parallel pattern (75%), while the remainder showed homogeneous pigmentation. A blurry proximal margin was observed in 50% of cases, and blurry lateral borders in 33.3%.

Pseudo-Hutchinson's sign was present in 4 nails (33.3%), whereas Hutchinson's and micro-Hutchinson's signs were absent in all cases. Additional associated features included splinter hemorrhages, distal onycholysis, and subungual hyperkeratosis (each in 25% of cases), as well as surface scaling (16.6%).

These cases were frequently associated with onychophagia, overlapping toes, or the use of tight footwear (Fig. 77).

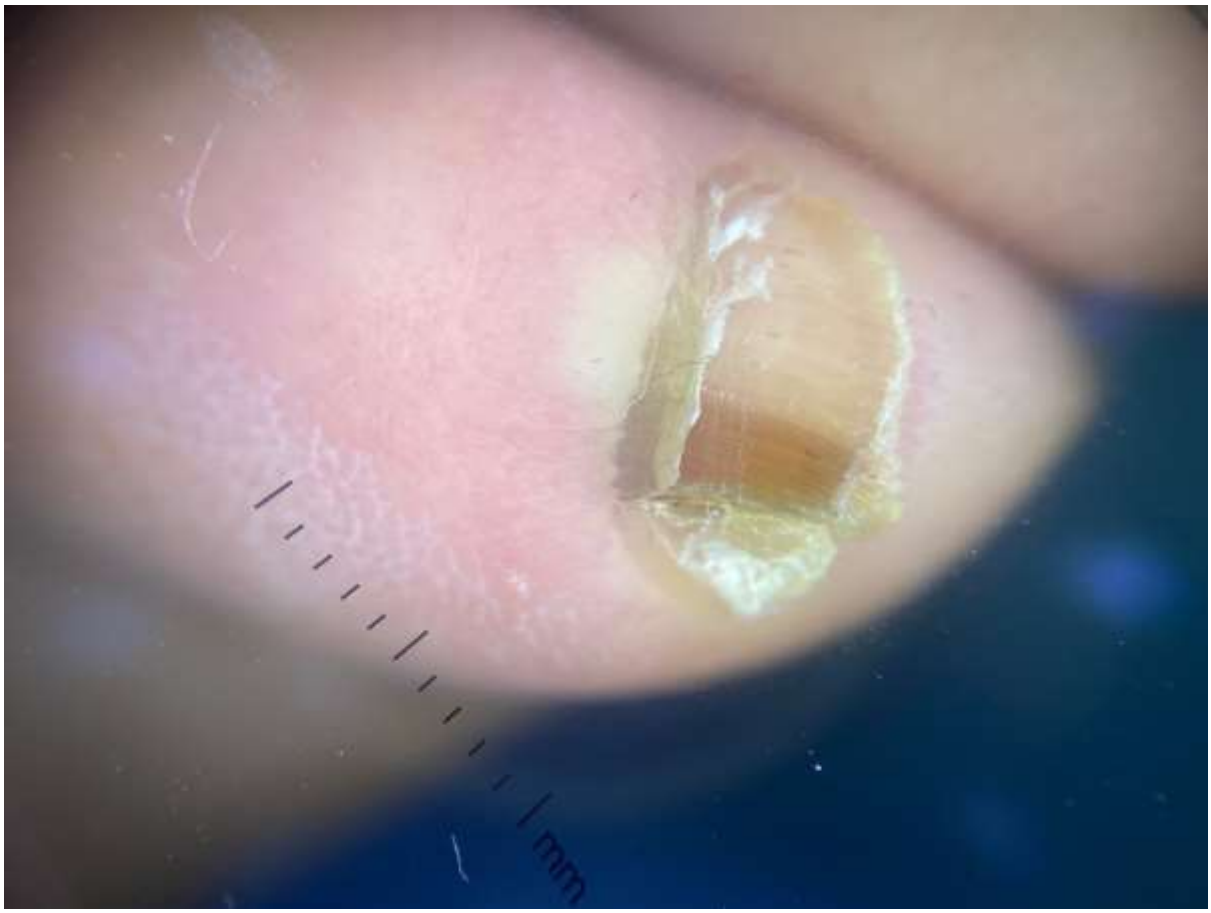

Figure 77 Frictional melanonychia of the fifth toe. Dermoscopy reveals a ***homogeneous light brown longitudinal band****, consistent with melanocytic activation, associated with a* ***distal splinter hemorrhage*** *and* ***localized periungual hyperkeratosis****, suggestive of chronic mechanical trauma*

- Post-traumatic Melanonychia

Post-traumatic melanonychia was identified in 10 nails (1.9%), all presenting as monodactylic, longitudinal rectangular bands. A homogeneous pattern was observed in 70% of cases, while a regular parallel pattern was seen in 2 nails, and an irregular pattern in 1 case. Blurry lateral borders were noted in 50% of cases.

Nail dystrophy was present in 4 cases, and splinter hemorrhages were detected in 1 case (10%). Regarding periungual pigmentation signs, Hutchinson's sign was observed in 1 case, pseudo-Hutchinson's sign in 2 cases, and micro-Hutchinson's sign was absent in all cases.

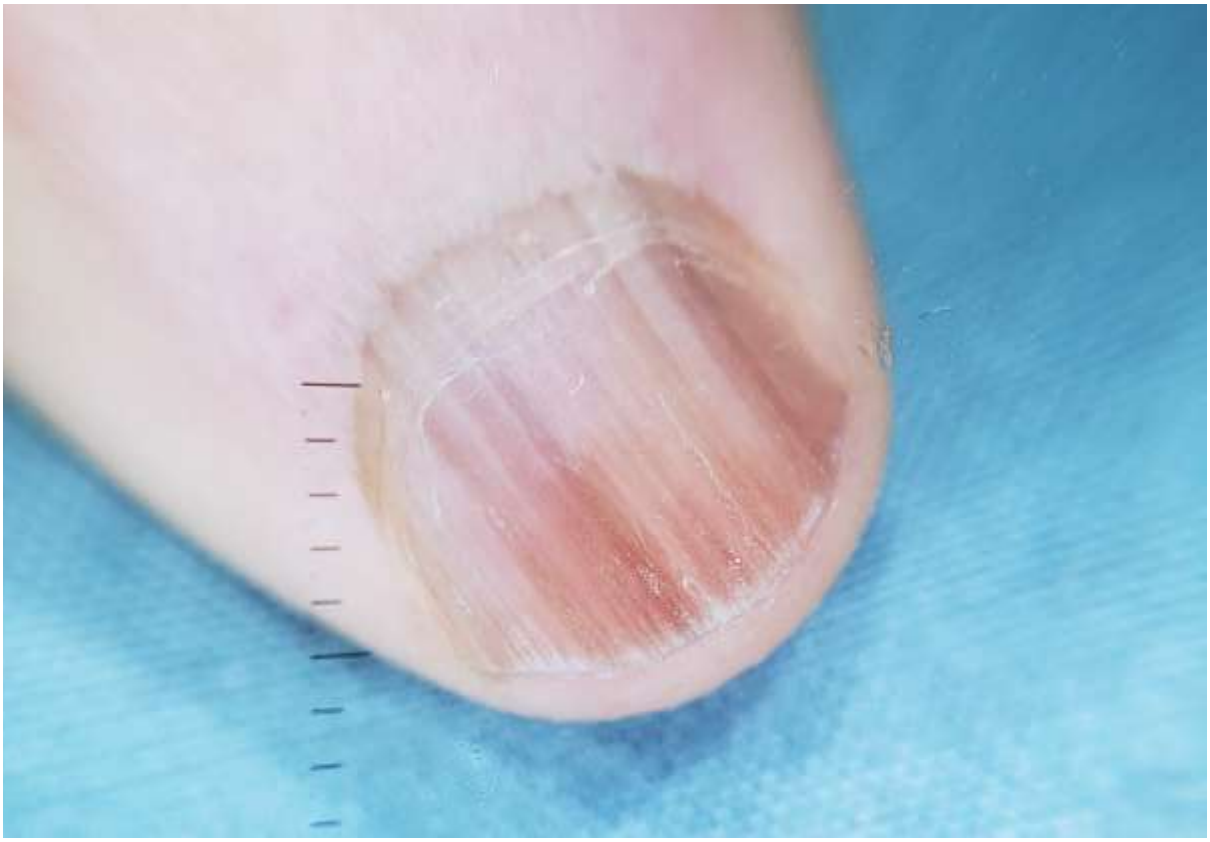

Figure 78 Post-traumatic melanonychia with nail plate surface irregularities

- Nonmelanocytic nail tumors

Benign tumors of the nail unit were also represented, with 8 cases of onychopapilloma, 2 cases of onychomatricoma, and 1 glomus tumor.

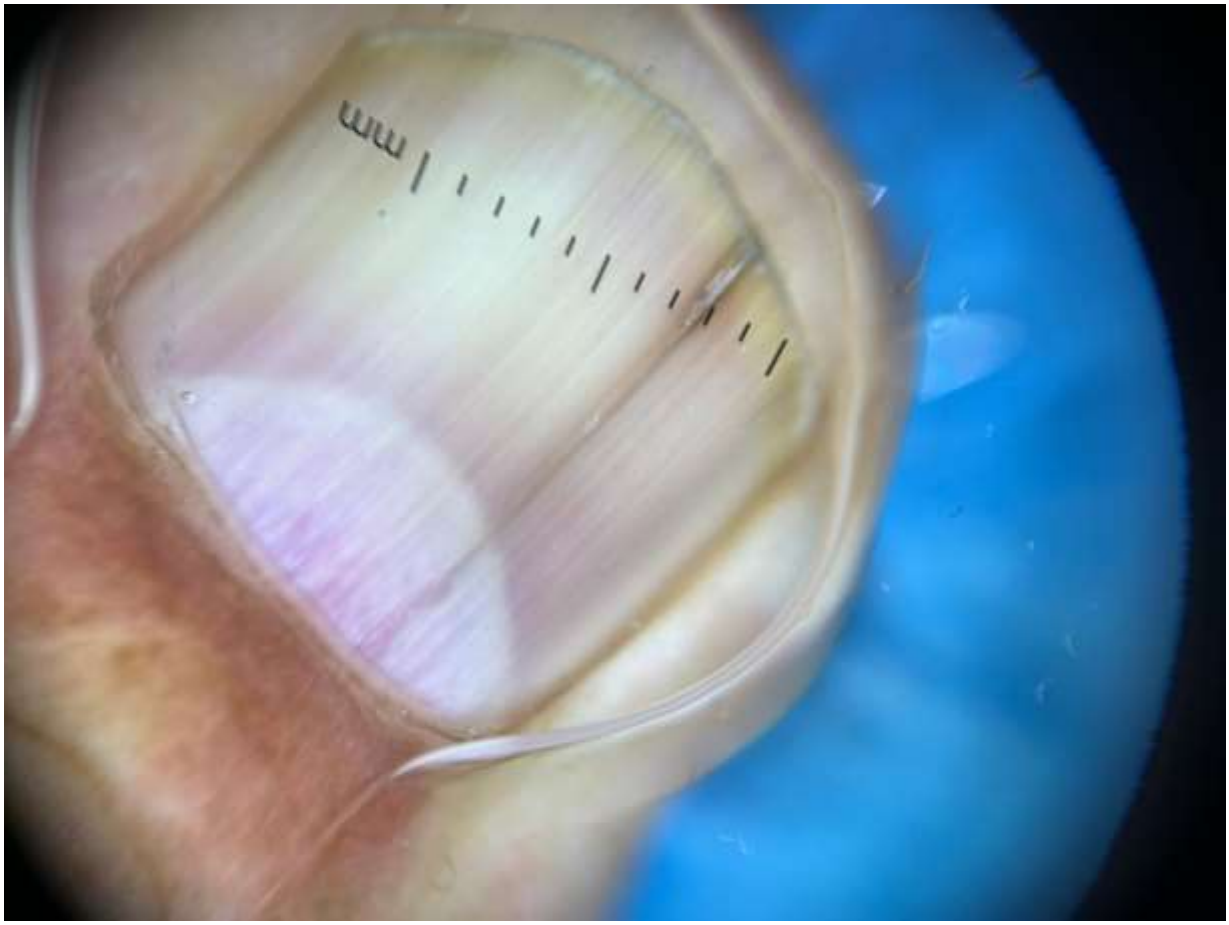

Figure 79 Longitudinal melanonychia with associated distal fissuring and indentation of the lunula, suggestive of underlying matrix pathology.

- Systemic Diseases

No cases of systemic disease (e.g., Addison's disease) were confirmed in this cohort as a primary cause of melanonychia.

b. Melanocytic Proliferation

- **Nail Matrix Nevus**

Nail matrix nevi presented as monodactylic longitudinal melanonychia and were divided into two categories: congenital and acquired, each displaying distinct dermoscopic characteristics.

Congenital Nail Matrix Nevi (Fig. 80): Identified in 6 nails, with one excluded due to associated subungual melanoma. These lesions most commonly exhibited a brown-dark color, while one case appeared black. All congenital nevi appeared as rectangular longitudinal bands with variable widths. Irregular patterns were present in approximately 80% of cases, characterized by irregularity in line width, spacing, or parallelism. A homogeneous background was seen in all cases. Notably, pseudo-Hutchinson's sign was present in all cases. Free edge dermoscopy showed involvement of the proximal matrix in 3 cases and pigmentation of the full thickness of the nail plate in 2.

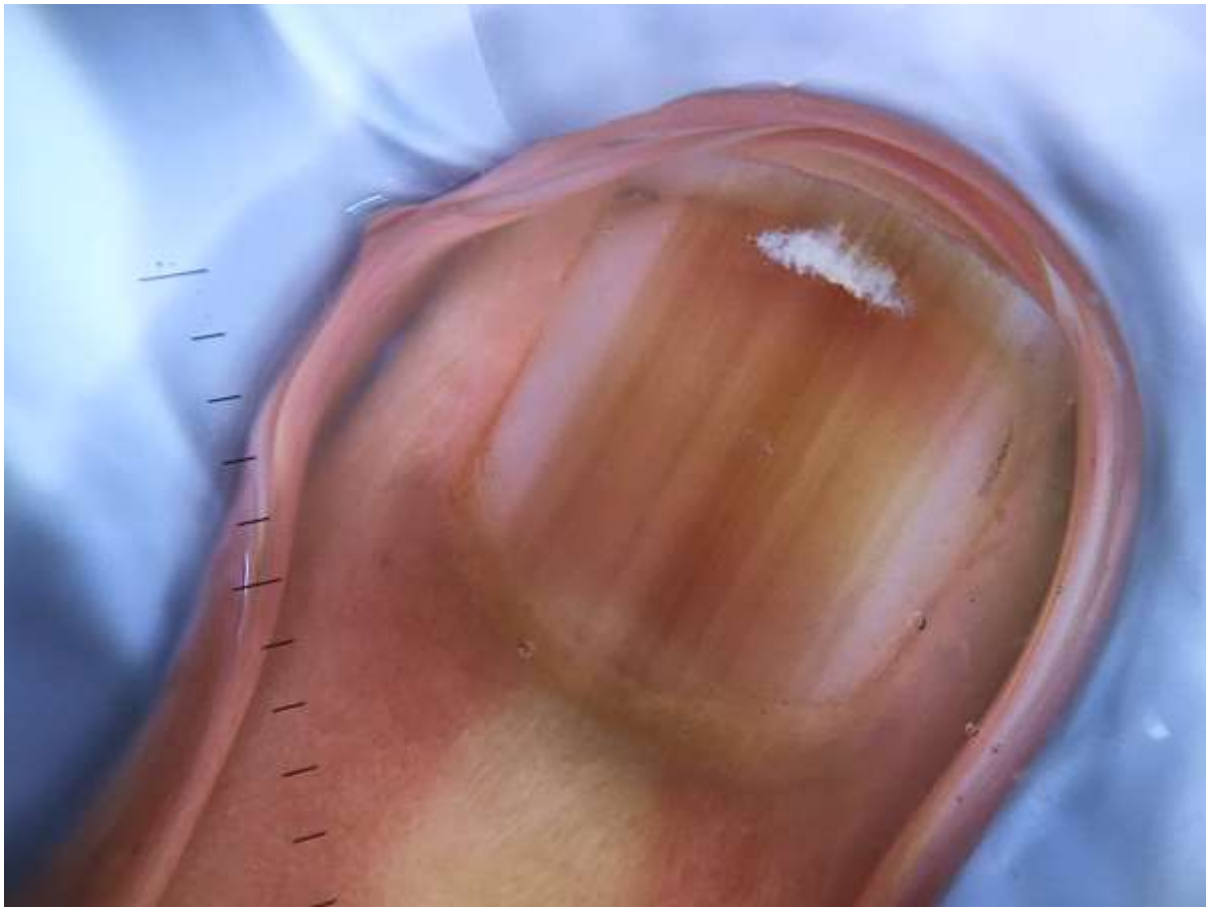

Figure 80 Congenital nail matrix nevus presenting as a wide longitudinal melanonychia with parallel lines of irregular spacing and variable width. A pseudo-Hutchinson's sign is also observed.

Acquired Nail Matrix Nevi (Fig. 81): Found in 6 nails, these showed more variability in presentation. Black pigmentation predominated (66.7%), followed by brown (33.3%). Two-thirds of lesions exhibited a rectangular shape, while one-third were triangular. Regular patterns were seen in half of the cases, with most respecting parallelism and regular thickness, and about half showing regular spacing. Hutchinson's sign was observed in 33.3%, pseudo-Hutchinson's in 50%, and micro-Hutchinson's in 16.7%. A homogeneous background was observed in all acquired cases.

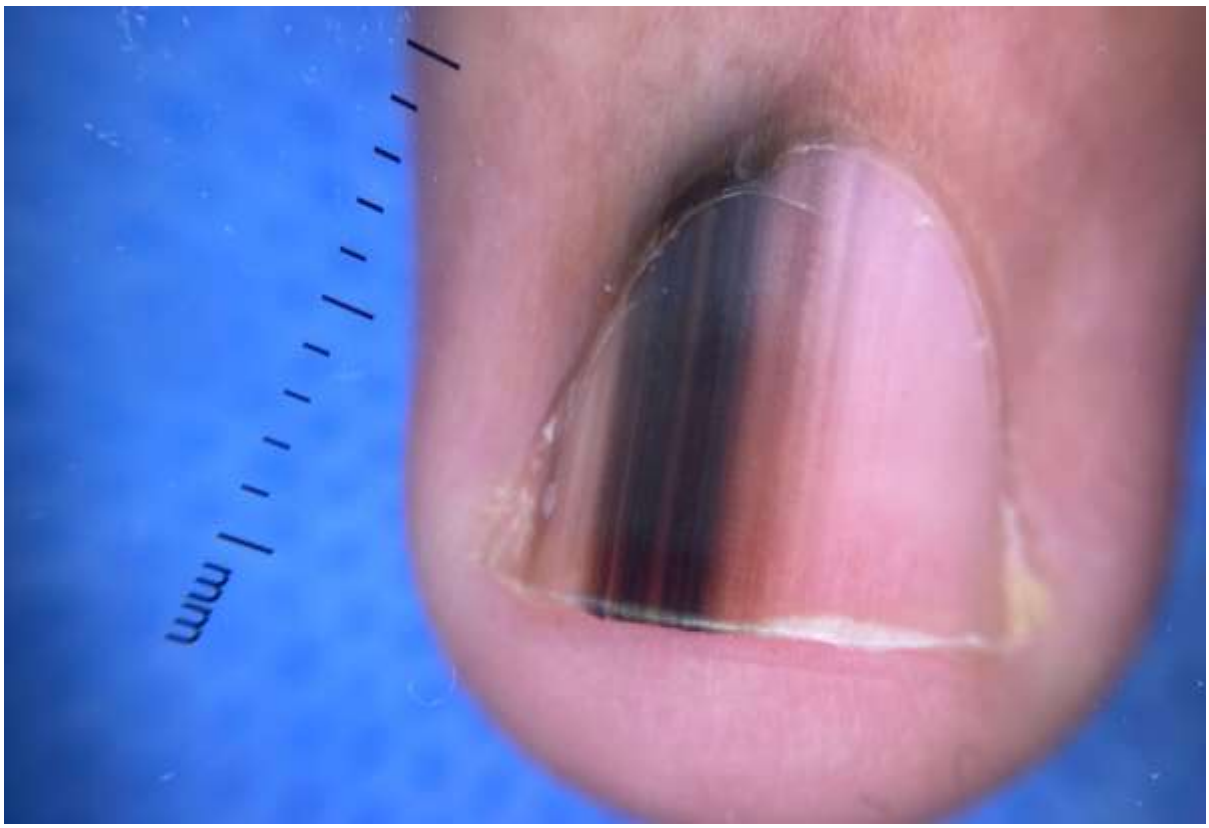

Figure 81 Acquired nail matrix nevus (biopsy-confirmed) presenting with irregular longitudinal lines, a heterogeneous pigmented background, and a Hutchinson's sign.

- Lentigo

Lentigo affected 10 nails (1.8%) and was mainly Monodactylic (80%). Bands were homogeneous, gray, or light brown (Fig. 82). Dermoscopic lines were regular, though hardly distinguishable, with some spacing irregularity (30%).

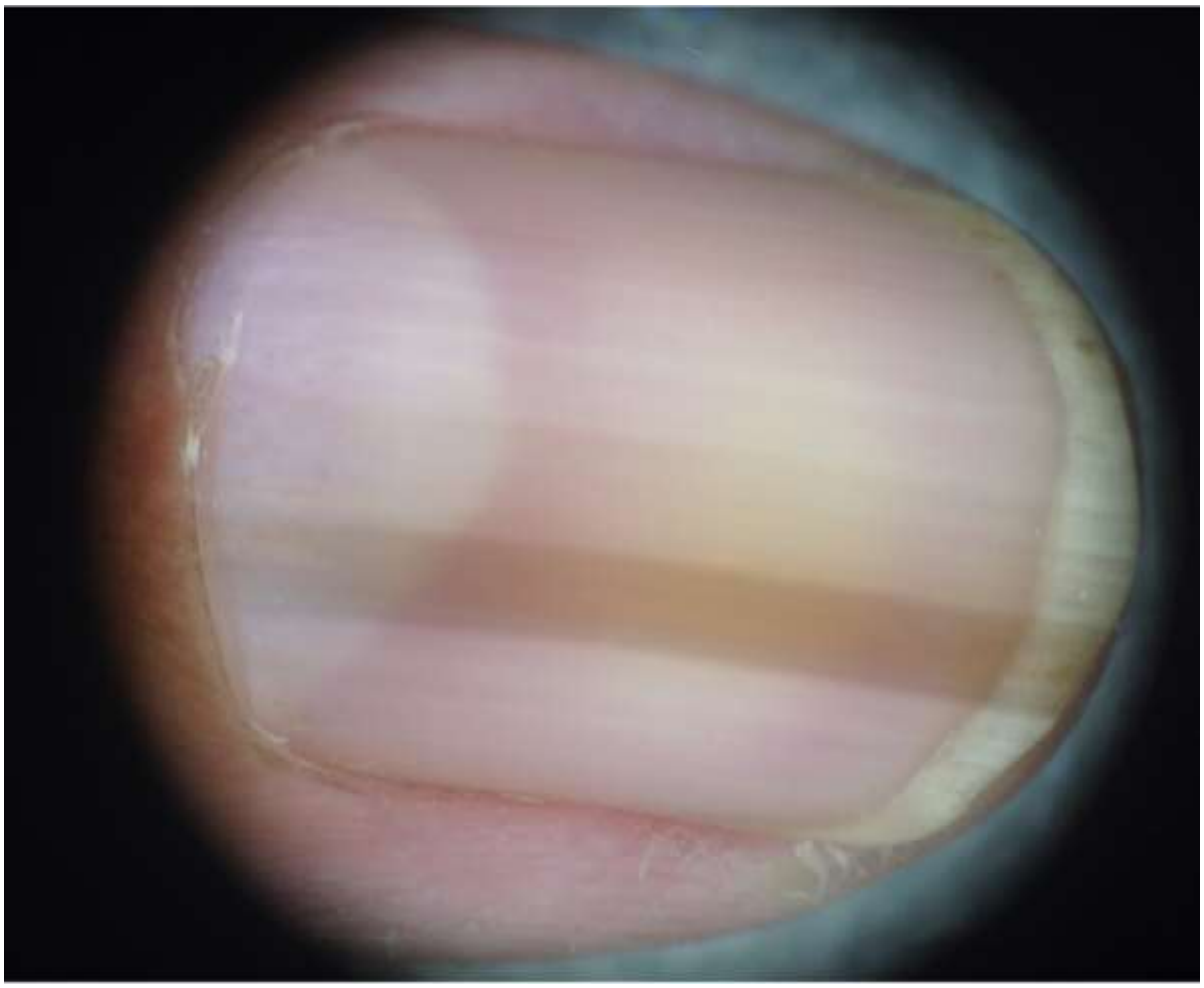

Figure 82 Nail Lentigo presenting as a homogenous longitudinal melanonychia

- Subungual Melanoma

Subungual melanoma was histologically confirmed in 7 nails (1.3%). All lesions demonstrated more than three line colors and exhibited irregular parallel lines. Specific irregularities included loss of parallelism in 28.5%, irregular spacing in 85.7%, and irregular line thickness in 71.4% of cases. The pigmented band was rectangular in shape in all cases.

Hutchinson's sign was universally present. In our cohort, this sign was attributable to the extension of pigment onto the lateral nail folds or the hyponychium. Notably, none of the cases showed actual invasion of the cuticle

or eponychium. A parallel ridge pattern in the hyponychium was observed in 85.7%, and full-thickness pigmentation of the nail plate was noted in 71.4% of cases (Fig. 83). Regarding the width of the pigmented band, 2 cases involved less than one-third of the nail, 3 between one-third and two-thirds, and 2 cases affected more than two-thirds of the nail width.

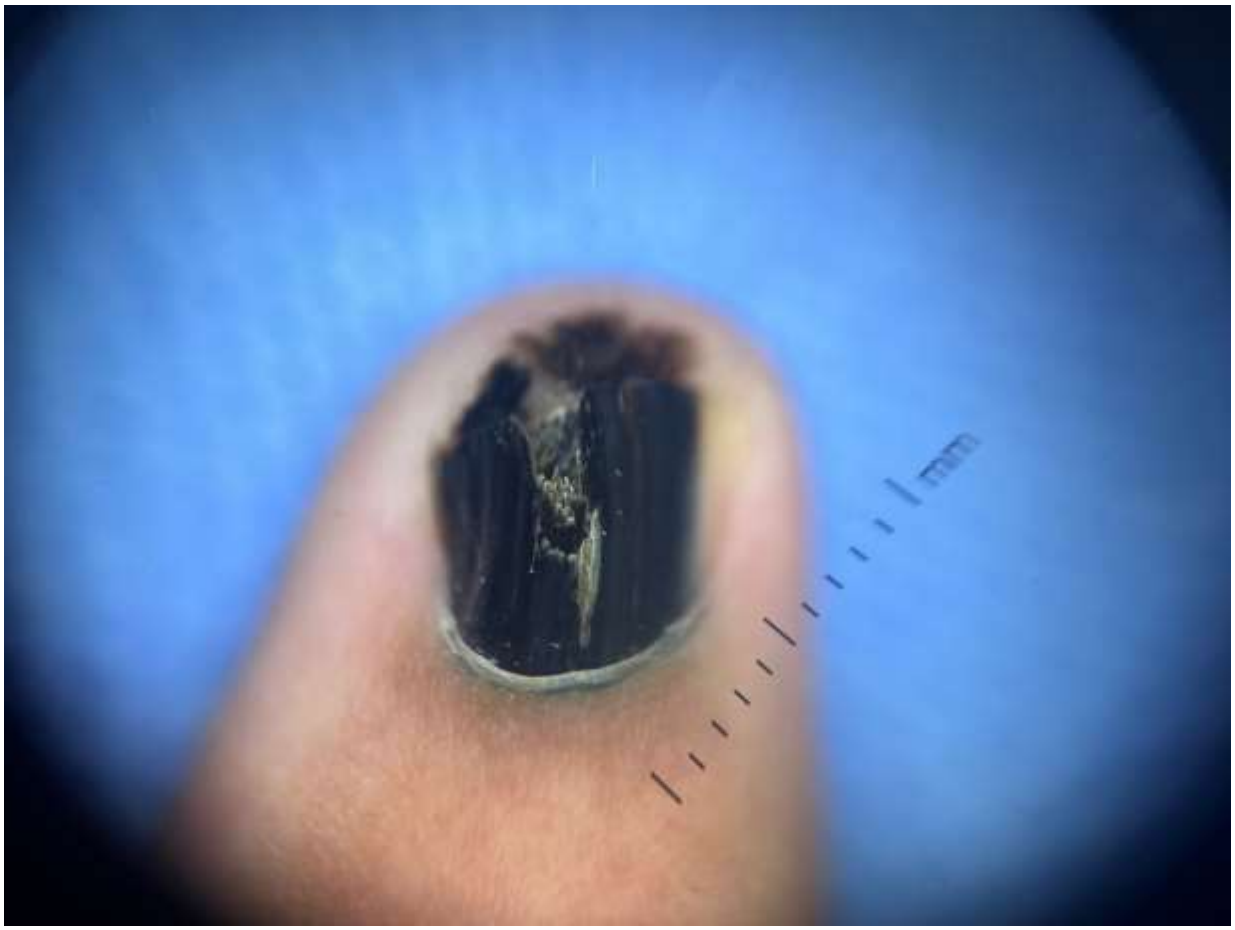

Figure 83 Nail apparatus melanoma arising within a congenital nevus, presenting with ***nail plate fissuration*** *and* ***hyponychial involvement****, without* ***cuticle extension****, in a 30-year-old patient.*

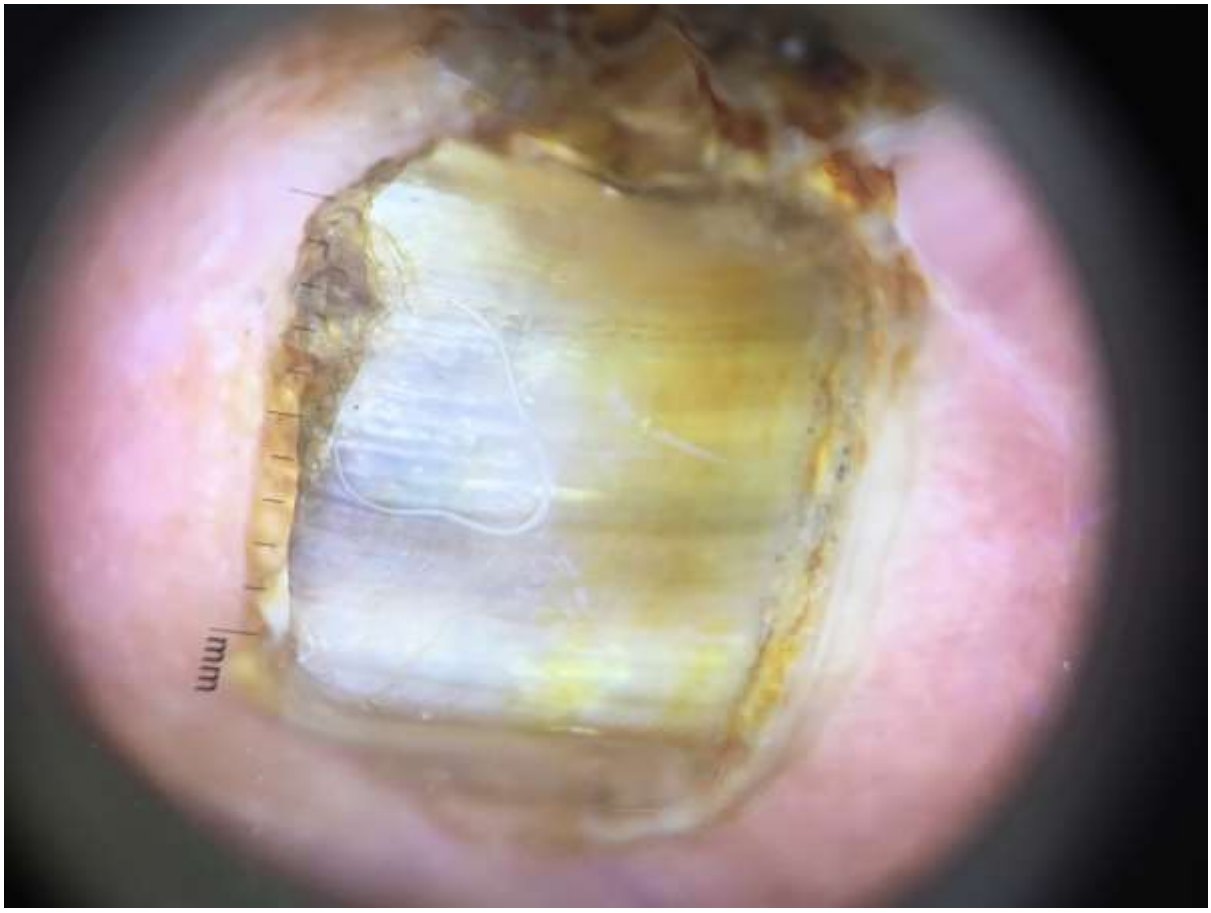

Figure 84 A case of nail apparatus melanoma with onychomycosis, showing homogenous fine gray longitudinal bands, with lateral periungual skin involvment

c. Non-Melanocytic Melanonychia

- Subungual Hemorrhages

Subungual hemorrhage was identified in 8 nails (1.5%). All were monodactylic, presenting with dark brown to black discoloration, a granular dermoscopic pattern, and absence of a defined band structure. Pigment location was mostly distal, and splinter hemorrhages were noted in 87.5% of cases (Fig. 85).

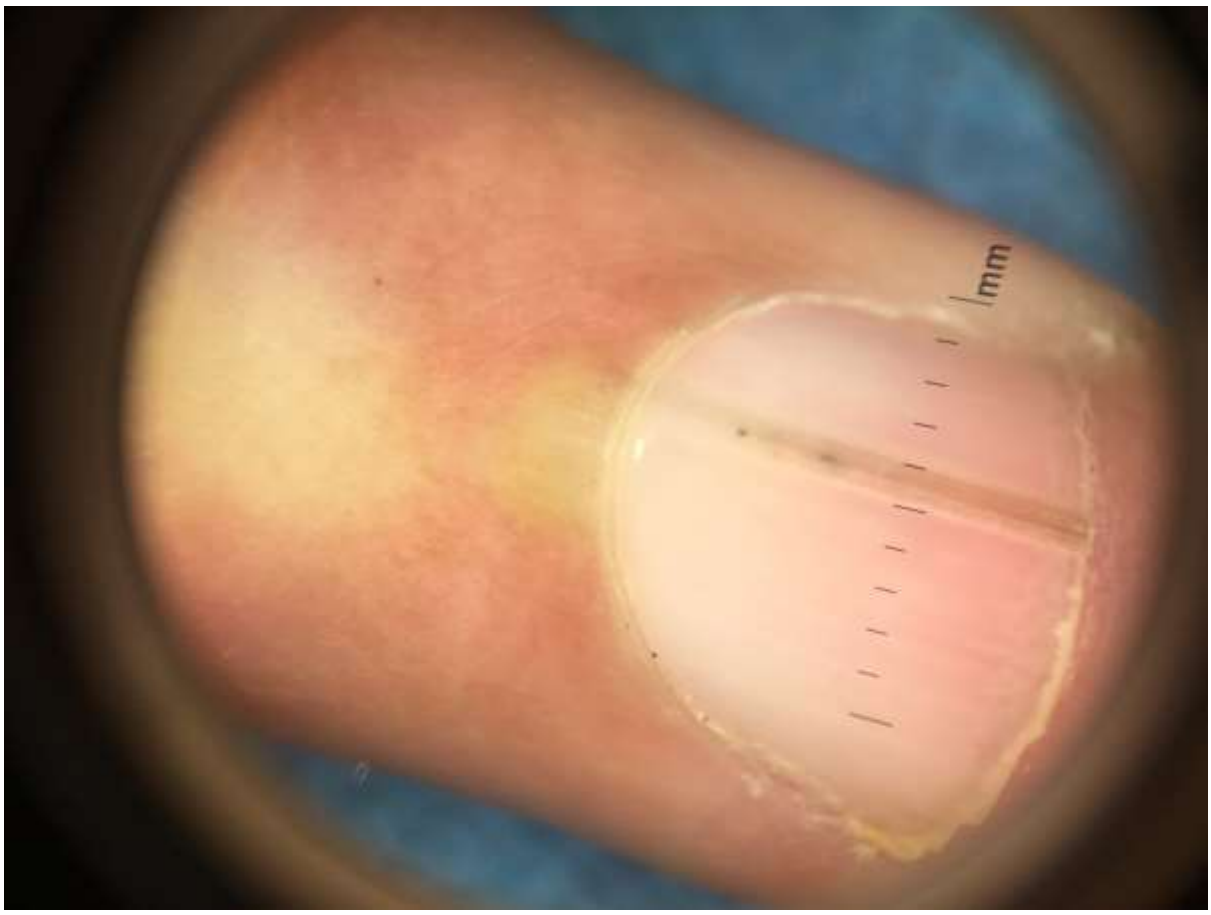

Figure 85 Longitudinal melanonychia histologically confirmed as a hematic deposit, with no evidence of melanocytic proliferation or activation, and no associated nail unit tumor.

- Fungal Melanonychia

Fungal melanonychia, confirmed through mycological examination, emerged as the second most common cause of melanonychia in our series, affecting 137 nails (25.0%). The condition was predominantly polydactylic, seen in 73.7% of cases, with the big toenail being the most frequently involved digit (41.6%). The pigmentation ranged in color from gray to light brown or yellowish, and most bands were rectangular in shape (75.1%). Less commonly, reverse triangular (12.4%) and triangular (0.72%) patterns were noted. A homogeneous dermoscopic pattern was observed in 68.6% of the affected nails.

Clinically, onycholysis was present in 89.1% of cases, followed by subungual hyperkeratosis (80.3%) and scaling (71.5%). Nail dystrophy was observed in approximately 28.5% of cases.

Trichophyton rubrum was identified as the most common pathogen (95 cases), followed by Candida albicans in 37 cases (Fig. 86).

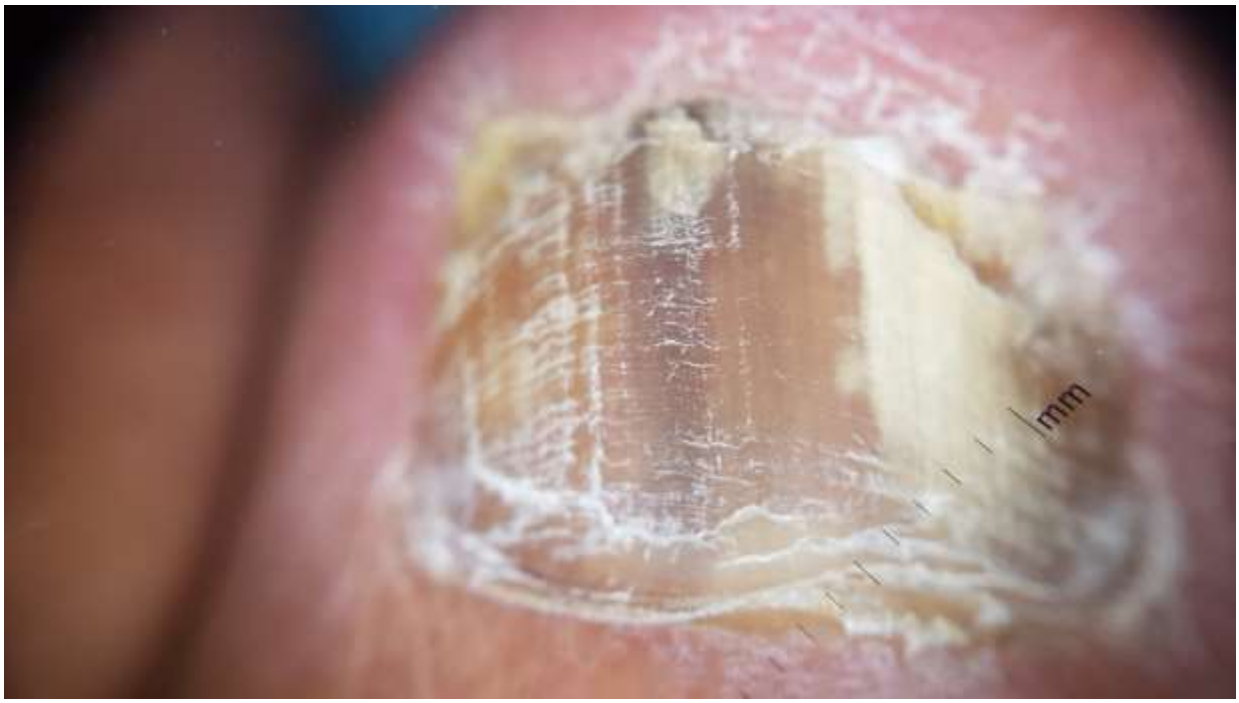

Figure 86 Onychomycosis due to Trichophyton rubrum, presenting as homogeneous melanonychia associated with onycholysis, surface scaling of the nail plate, subungual hyperkeratosis, and areas of leukonychia.

- Bacterial Melanonychia

One case (0.2%) was attributed to *Pseudomonas aeruginosa*, presenting with characteristic green-black pigmentation and diffuse nail discoloration. (Fig. 87)

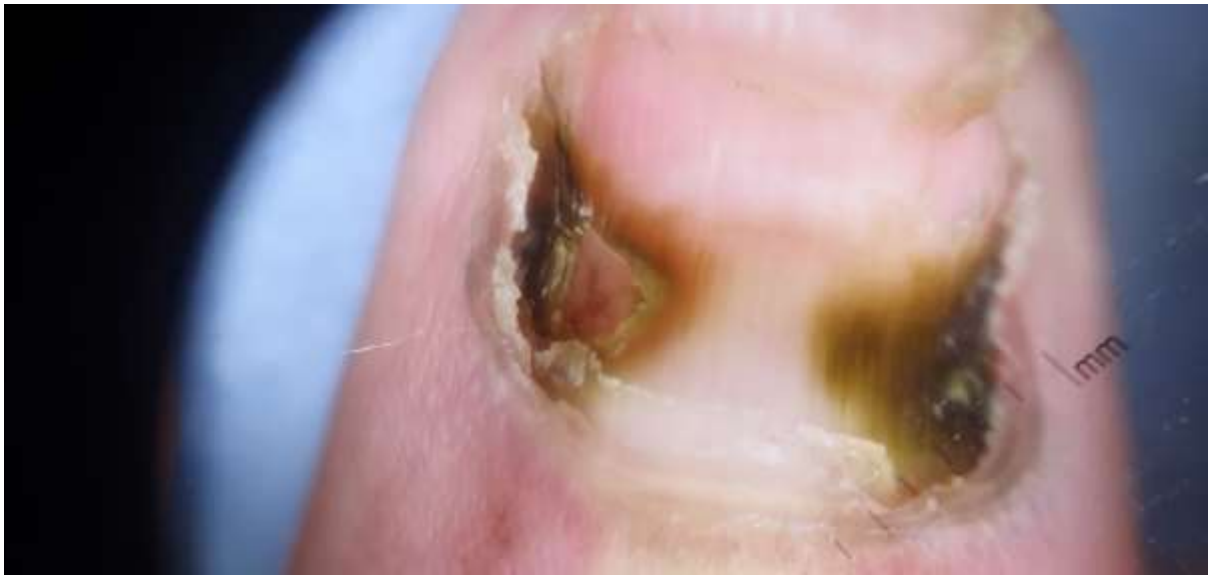

Figure 87 Dermoscopic image of a pseudomonas nail infection showing green to black discoloration along the lateral nail margins, central yellow-green pigmentation, irregular pigment borders, and onycholysis.

- Exogenous Pigmentation

Exogenous causes, such as henna or dye exposure, accounted for 8 nails (1.5%). The pigmentation was typically dark brown or black, irregular, and diffusely distributed, lacking any internal structure. On dermoscopy, the color appeared lighter and showed no discernible lines or patterns, which helped distinguish it from melanocytic pigmentation. Notably, the discoloration disappeared upon nail cleaning or gentle scraping (Fig. 88).

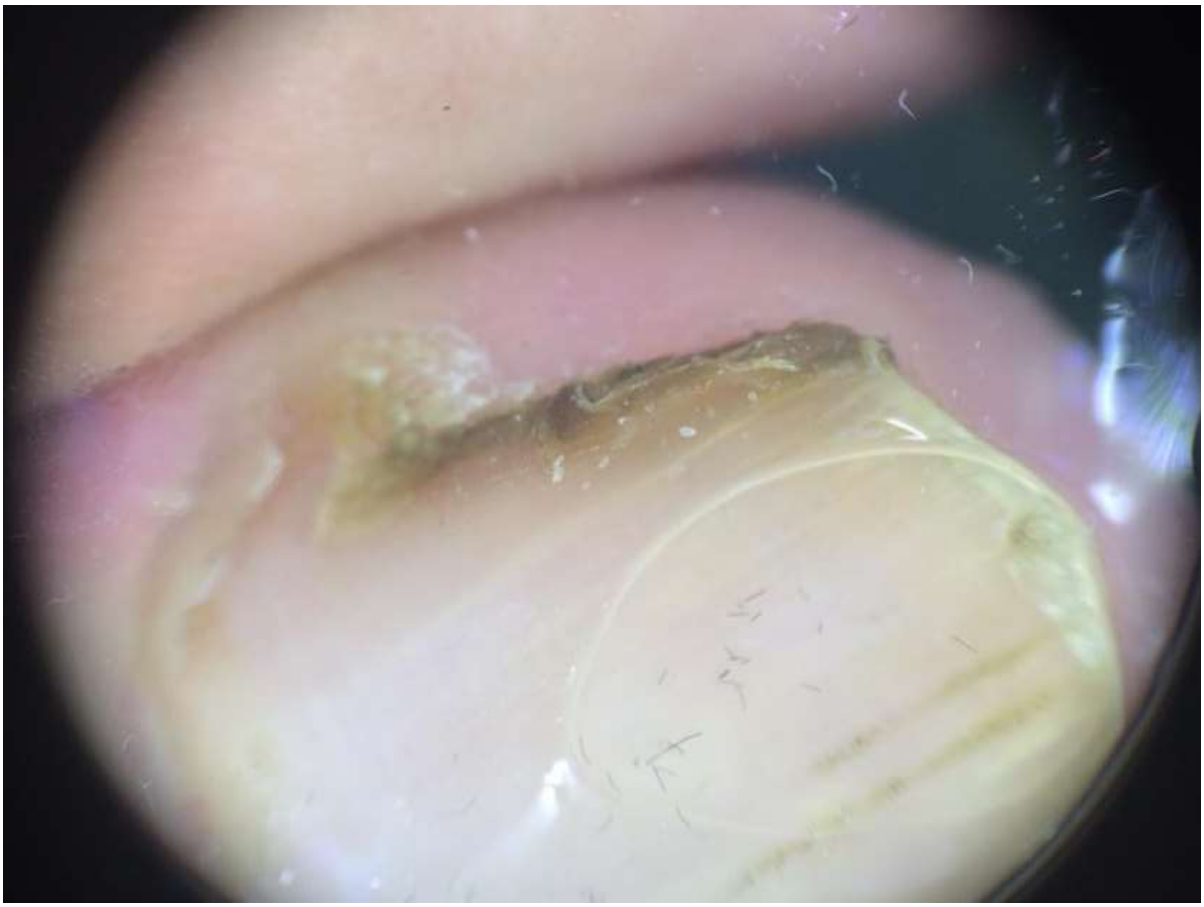

Figure 88 Exogenous melanonychia caused by debris inclusions beneath the lateral margin of the nail plate.

II. Analytical Study

1. Association Between Band Characteristics and Etiology

Band Shape showed a statistically significant association with the underlying etiology of melanonychia ($p = 0.015$). Rectangular bands were the most frequently observed shape across most etiologies; however, triangular and reverse triangular shapes were more frequently associated with melanocytic proliferations and traumatic causes. Arciform bands were occasionally linked to inflammatory or infectious conditions, while nonspecific shapes were more common in exogenous and drug-induced pigmentation.

Band Color also demonstrated a significant association with etiology ($p = 0.034$). Gray and gray brown were common in benign and racial causes, while darker hues such as black and multicolor pigmentation were more often observed in subungual melanoma and drug-induced melanonychia. Light brown was frequently seen in onychomycosis and inflammatory conditions.

2. Free Edge Dermoscopy and Etiology

A highly significant association was found between **free edge pigmentation patterns** and melanonychia etiology ($p < 0.001$). Pigmentation located in the lower part of the free edge was most common in fungal melanonychia and racial pigmentation. In contrast, diffuse or full-thickness pigmentation patterns were more indicative of melanocytic lesions or drug-induced changes. Absence of free edge pigmentation was more common in traumatic and exogenous pigmentation.

3. Dermoscopic Color Variability and Etiology

The **number of pigmentation colors observed under dermoscopy** varied significantly across etiologies ($p = 0.011$). Monochromatic patterns were predominantly seen in racial and benign melanonychia. In contrast, multicolor patterns (two or more colors) were more commonly associated with subungual melanoma, drug-induced melanonychia, and inflammatory disorders, possibly reflecting greater pigment irregularity or depth.

A significant difference was also noted between **clinical (naked eye) and dermoscopic pigmentation colors** ($p = 0.019$). In several cases, the

dermoscopic examination revealed lighter pigmentation than perceived clinically. This discrepancy was more frequent in drug-induced and exogenous melanonychia, likely due to differences in pigment density and location within the nail plate.

4. Non-Significant Associations

No statistically significant associations were observed between the etiologies of melanonychia and:

- Presence of Hutchinson's sign ($p = 0.283$),
- Pseudo-Hutchinson's sign ($p = 0.497$),
- Micro-Hutchinson's sign ($p = 0.419$),
- Number of involved nails (monodactylic vs. polydactylic; $p = 0.374$),
- Nail surface changes such as dystrophy, pachyonychia, or onycholysis.

These findings suggest that while nail fold pigmentation and associated dystrophic changes may support clinical impressions, they are not reliable indicators for specific etiologies when analyzed statistically.

Table 1 Nail Characteristics by Etiology of Melanonychia

Characteristic	NAM	NMN	Lentigo	Racial	Drug-induced	p-Value
Number of nails involved	100% monodactylic	100% monodactylic	Mostly monodactylic	0% monodactylic (100% poly-)	36.4% polydactylic	< .001

Characteristic	NAM	NMN	Lentigo	Racial	Drug-induced	p-Value
Band shape	Rectangular 71.4%	Rectangular 66.7%	Rectangular 80.0%	Rectangular 77.6%	Non-specific 40.9%	NS
Monochromatic bands	14.6%	—	33.3%	77.6%	27.3%	0.011
Multichromatic bands	85.4%	100%	66.7%	22.4%	72.7%	< .001
Black band color	42.9%	100%	33.3%	18.4%	59.1%	0.002
Gray band color	—	—	—	26.3%	4.5%	NS
Gray-brown color	—	—	—	50.0%	22.7%	NS
Color difference (DSC vs. Clinical)	0%	0%	0%	10.5%	45.5%	0.019
Free edge DSC pigmentation	Mostly full thickness	Mostly full thickness	Mostly full thickness	Lower part 76.3%	Full thickness 50%	< .001
Hutchinson's sign	100%	33.3%	0%	0%	4.5%	< .001
Pseudo-Hutchinson's sign	85.7%	16.7%	0%	21.1%	31.8%	0.052

DISCUSSION:

Melanonychia, defined as brown or black pigmentation of the nail plate, represents a frequent diagnostic challenge in dermatology. It can result from a broad spectrum of etiologies, ranging from benign melanocytic activation or hyperplasia to malignant melanoma of the nail apparatus.[5,17] The pigmentation may appear longitudinal, transverse, or diffuse, with LM being the most common presentation.[3,6] Recognizing its clinical relevance is crucial, particularly because early-stage NAM, a potentially life-threatening neoplasm, can mimic benign lesions in its initial stages.[11,22]

I. Epidemiological and Demographic Characteristics

The demographic data of our cohort, comprising 160 patients and a total of 548 affected nails, underscores the heterogeneous presentation of melanonychia.

1. Sex and Age Distribution:

The mean patient age was 50.18 years (±16.02), with an age range from 3 to 80 years, and a female predominance (96 females vs. 64 males), a trend similarly reported in other population-based studies.[36,39–41] This female predominance may reflect greater health-seeking behavior among women or sex-related biological variation in nail pigmentation patterns.

2. Phototype Distribution:

The majority of patients in our cohort had Fitzpatrick phototype IV (n = 90), followed by phototype III (n = 44), phototype V (n = 22), and phototype VI (n = 5). This distribution reflects the general population profile in Morocco and supports existing data showing a higher prevalence of melanonychia among individuals with darker skin tones (phototypes IV–VI).[1,30,36,40] In these patients, melanonychia is often physiological and polydactylous, with benign dermoscopic features.

Importantly, skin phototype plays a critical role in the **clinical interpretation** of longitudinal melanonychia. In darker phototypes, LM is frequently benign and attributable to baseline melanocytic activity, [30] whereas in lighter-skinned individuals, particularly phototypes I and II, any new onset of a pigmented band — especially if affecting a single digit after the fourth decade of life — warrants thorough evaluation for possible subungual melanoma. [4,5]

Although phototypes I and II were underrepresented in our cohort, the diagnostic principles derived from skin phototype stratification remain broadly applicable and serve as a valuable guide for clinical decision-making, particularly in differentiating physiologic pigmentation from pathology.[5]

3. Familial History and Hereditary Factors

A family history of melanonychia was reported in 12.5% of patients, suggesting a possible hereditary component, particularly in benign conditions

like nail matrix nevi and ethnic melanonychia.[11,30] Although the genetic mechanisms remain incompletely understood, familial aggregation of melanocytic lesions has been documented, supporting the role of inherited factors.[42]

Ethnic melanonychia, while often associated with higher Fitzpatrick phototypes (IV–VI), is increasingly recognized in the literature as being **linked not solely to phototype, but also to ethnic genetic traits** that promote baseline melanocytic activation in the nail matrix.[30,36,40] This helps explain its occurrence even in individuals with moderate pigmentation, reinforcing the idea that **ethnicity and hereditary background are as important as skin tone in clinical assessment**.

II. Clinical and Dermoscopic Findings

1. Clinical Characteristics of Melanonychia

Our cohort of 160 patients presented with a diverse range of clinical manifestations of melanonychia, affecting a total of 548 nails. These findings offer important insights into the patterns, presentations, and diagnostic nuances of this condition.

a. Monodactylic vs. Polydactylic Involvement

Nearly half of the patients (48.1%) exhibited monodactylic melanonychia, while a slightly higher proportion (51.9%) had polydactylic involvement. This nearly equal distribution underscores the clinical variability

of melanonychia and highlights the importance of distinguishing between isolated and widespread involvement when assessing underlying etiology. Notably, polydactylic cases involved a far greater total number of nails (440 vs. 108), and in 26 patients, all 20 nails were affected, a pattern strongly suggestive of ethnic melanonychia or systemic causes such as drug-induced pigmentation or dermatoses.[2,3,30] In contrast, monodactylic involvement, particularly of the thumb, big toe, and index finger, raises greater concern for localized melanocytic proliferations, including nail matrix nevi or melanoma, especially in adults.[34,35,43]

b. Types of Melanonychia

Longitudinal melanonychia (LM) was the predominant pattern, observed in 83.4% of affected nails. This aligns with existing literature identifying LM as the most common clinical type across both benign and malignant melanonychia etiologies.[3,23] The width of the pigmented bands was also informative: in over 80% of cases, the band occupied less than one-third of the nail plate, suggesting a benign process. However, wider bands—particularly those exceeding two-thirds of the nail width—warrant closer scrutiny, as this finding has been associated with melanocytic hyperplasia or melanoma.[4,5,17] Transverse melanonychia, though less frequent (10%), was typically linked to systemic or exogenous causes,[18,23,31] while total melanonychia and nonspecific patterns were rare and often posed a diagnostic challenge due to their lack of specific morphological clues.[23]

c. Band Shape

Band morphology provided additional diagnostic value. Rectangular bands were by far the most frequent (80.5%) and were typically associated with regular melanocytic activation, particularly in ethnic melanonychia or benign nevi. Reverse triangular bands, a pattern sometimes seen in onychomycosis[44], were found in 5.1% of nails, and triangular bands in 1.1%, highlighting the need for vigilance when assessing tapering toward the proximal or distal matrix.[33,45] Arciform and non-specific band shapes, although less common, emphasized the heterogeneity of presentations and the need for contextual dermoscopic correlation.

d. Band Color

Color analysis revealed that gray-brown (44.2%) and light brown (21.7%) were the most common shades, typically associated with benign conditions. Gray and dark brown bands were moderately represented, while black pigmentation was uncommon (3.8%) but notable, as it may reflect higher melanin density, hemorrhage, or malignancy.[2,5,45] Multicolored bands, observed in only 1.3% of nails, were strongly associated with melanoma in our series, in keeping with the diagnostic weight of color variegation in dermoscopic evaluation.[2,5]

e. Associated Nail Changes

Nail changes accompanying melanonychia served as important secondary diagnostic indicators. The most common alterations included distal

onycholysis, nail plate scaling, and subungual hyperkeratosis, findings often associated with onychomycosis, dermatoses, benign nail tumors, or trauma. Nail dystrophy and splinter hemorrhages, while less common, may indicate more chronic or severe underlying pathology, including tumors.[1,4] Rare findings such as dorsal pterygium and paronychia likely reflect coincidental or disease-specific comorbidities.[46] Importantly, the presence of multiple nail abnormalities should prompt thorough evaluation for non-melanocytic causes or concurrent conditions.[20,21]

2. Dermoscopic Features of Melanonychia

Dermoscopic evaluation of melanonychia in our cohort revealed several clinically relevant patterns, reinforcing its indispensable role in the diagnostic workup, particularly in differentiating benign from malignant lesions.

a. Background Color

The background color observed under dermoscopy varied considerably, with gray being the most prevalent (62.0%), followed by light and dark brown. This predominance of gray pigmentation is consistent with findings in ethnic or benign melanonychia, where melanin production is generally lower, and the pigment is either diffusely distributed or deposited in deeper layers of the nail plate, resulting in a lighter, grayish appearance. [4,15] The presence of multicolored backgrounds, although rare (2.9%), was primarily associated with melanocytic lesions requiring further evaluation, as color diversity is a known indicator of malignancy.[5]

b. Number of Colors

When examining the number of colors per band, most cases demonstrated uniformity, with a single color identified in 63.0% of nails. However, nails with two or more colors (up to five in rare instances) warrant attention, as polychromy often correlates with atypia or malignancy, as supported by dermoscopic malignancy criteria. [1,5,22] A lighter dermoscopic appearance of pigment compared to the clinical view was observed in 23.0% of nails. This can result from either superficial melanin deposits with reduced optical density or the Tyndall effect, where light scattering makes the pigment appear grayer despite a darker clinical hue.[2,30]

c. Line Color

Analysis of dermoscopic line color further supported diagnostic differentiation. Gray and light brown lines were most common, consistent with benign melanocytic activation. In contrast, dark brown, black, or gray-blue lines—though less frequent—appeared more often in cases with concerning clinical or dermoscopic features. This aligns with literature noting that darker pigmentation and color variegation may indicate increased melanin production or deeper pigment localization, features seen more frequently in melanomas.[1,4,5]

d. Dermoscopic Patterns

Regarding pattern morphology, the majority of nails showed either a homogeneous pattern (43.4%) or parallel longitudinal lines (53.6%). The

homogeneous pattern is often observed in benign conditions such as ethnic melanonychia or drug-induced pigmentation.[4,30] In contrast, structured longitudinal patterns—particularly those with atypical features like irregular spacing, thickness, or disrupted parallelism—were noted in a subset of nails (approximately 20%), many of which corresponded to nevi or melanomas, but also some melanocytic activation etiologies. These findings support existing algorithms that consider such irregularities as red flags for malignancy.[4,16,17,23,47]

e. Free Edge Dermoscopy

Free edge dermoscopy provided valuable insights into the localization and depth of pigmentation in melanonychia, serving as a non-invasive method to topographically assess the origin of melanogenesis. In our cohort, pigment was observed in the lower part of the nail plate in 258 nails (47.1%), which typically reflects melanocytic activation in the distal matrix. Conversely, pigmentation involving the upper portion of the nail plate—seen in 17 nails (3.1%)—indicates proximal matrix involvement. When pigmentation spanned the full thickness of the nail plate (7.3%), it suggested diffuse melanocytic activity, which may occur in both benign conditions (e.g., nail matrix nevi) and malignant lesions.[2,5]

Pigment located beneath the nail plate (4.6%) was generally associated with non-melanocytic melanonychia, where the pigmentation corresponded to subungual structures such as hyperkeratosis or hematomas. Notably, free edge dermoscopy also helped distinguish melanocytic activation from

proliferation: most cases of activation displayed pigmentation confined to the lower portion of the nail plate or no visible pigment at the free edge, supporting a limited and typically distal matrix origin. In contrast, nearly half of acquired nevi and 40% of congenital nevi in our study exhibited pigmentation spanning the entire nail plate thickness, indicating a broader zone of melanogenesis involving both proximal and distal matrix regions.[2]

Additionally, free-edge examination may uncover structural nail plate changes, such as thickening or ridging, which could point toward non-melanocytic tumors like onychopapilloma, onychomatrichoma, or Bowen disease.[1,2,4] Overall, these findings underscore the diagnostic value of free edge dermoscopy in evaluating pigment origin, depth, and associated pathology in melanonychia.

f. Periungual Dermoscopy

Periungual dermoscopic findings, particularly Hutchinson's sign and its variants, played a critical diagnostic role in our cohort. True Hutchinson's sign was identified in 4.2% of nails, and in all cases, it was associated with either histologically confirmed nail apparatus melanoma (NAM) or nail matrix nevus (NMN), confirming its high specificity for melanocytic proliferations. However, this also highlights that the sign, while highly suggestive of malignancy, is not pathognomonic.[5,25]

Pseudo-Hutchinson's sign, seen in 20.8% of nails, occurred more frequently in individuals with Fitzpatrick phototypes IV–VI and was associated with benign melanonychia, highlighting the importance of accurate

differentiation to prevent overdiagnosis.[5,22,24] Careful dermoscopic assessment allowed distinction between true and pseudo-signs based on pigment localization and structure.

Micro-Hutchinson's sign and the parallel ridge pattern were rare but, when present, showed strong correlation with NAM, supporting their inclusion in malignancy-focused dermoscopic checklists.[4,5,17] These findings collectively reinforce the utility of periungual dermoscopy in distinguishing benign from malignant nail pigmentation patterns.

III. Etiologies of Melanonychia

The etiological diversity observed in our cohort underscores the complexity of melanonychia and its varied pathophysiological mechanisms. Melanonychia may result from melanocytic activation, melanocytic proliferation, or non-melanocytic processes, each bearing distinct clinical and dermoscopic hallmarks. Our findings align with the broader literature but also reveal patterns unique to our population and methodological rigor, particularly due to our systematic clinical-dermoscopic correlation and large sample of 548 affected nails.

1. Melanocytic Activation

a. Racial Melanonychia

Melanocytic activation emerged as the most prevalent underlying mechanism, accounting for 58.6% of nails, with **racial or ethnic melanonychia**

being the single most common etiology (30.3% of cases). As expected, it consistently manifested as polydactylic longitudinal melanonychia, with over half of these patients displaying involvement of all twenty nails. The frequent observation of multiple bands per nail (53%) further supports the diagnosis of physiologic melanonychia due to increased baseline melanocytic activity, particularly in individuals with darker skin phototypes.[2,30]

The predominance of Fitzpatrick skin types IV–VI (84%) in this group aligns with established evidence that racial melanonychia is more common in heavily pigmented populations, where baseline melanocyte activity in the nail matrix often leads to benign longitudinal pigmentation.[3,30,48] Dermoscopically, this entity exhibited a highly characteristic pattern: a homogeneous gray background in nearly 85% of nails, with fine gray or light brown lines in most cases. These findings are indicative of superficial melanin deposition and melanocytic activation without proliferation, a hallmark of benign ethnic pigmentation.[2,30]

The absence of Hutchinson's sign in all cases and the presence of pseudo-Hutchinson's sign in a minority (16.3%) also reinforce the benign nature of this pattern.[2] Importantly, the recognition of this presentation is essential to avoid unnecessary biopsies or anxiety, particularly in patients with darker phototypes, where racial melanonychia is a physiologic norm rather than a pathologic finding.[2,30]

However, while racial melanonychia is typically benign, the presence of pigmentation in multiple nails does not categorically exclude melanoma.

Notably, Domínguez-Cherit et al.[36] (2008) reported melanoma in two out of three cases where longitudinal melanonychia involved more than one digit, underscoring the importance of careful assessment of all lesions, even in the context of polydactylic pigmentation.[36,48]

b. Drug-induced Melanonychia

Drug-induced melanonychia accounted for 10.9% of cases in our cohort, most frequently associated with chemotherapy, antiretrovirals, and other systemic medications. The condition typically presented as polydactylic involvement, with multiple nails affected concurrently. A notable proportion of these cases displayed multichromatic bands, often containing two or three distinct colors, and a frequent mismatch between clinical and dermoscopic pigmentation. These findings are consistent with prior reports attributing such patterns to the cytotoxic effects of certain drugs on the nail matrix melanocytes, resulting in irregular melanin deposition and altered pigment presentation.[4,6,49]

A characteristic feature observed in several drug-induced cases was transverse melanonychia, a relatively uncommon pattern in other etiologies. The transverse orientation of pigmentation supports a temporal association with drug exposure, corresponding to periods of systemic treatment.[18,19] This finding reinforces the importance of detailed treatment history in evaluating such presentations.

The predominance of dark gray-brown homogeneous backgrounds observed in our cases aligns with the pattern described by Jin et al.,[39] while

the high frequency of multicolor pigmentation—less commonly emphasized in existing literature—may serve as a useful clue in distinguishing drug-induced melanonychia from other benign etiologies. This reinforces the value of careful medication history and dermoscopic evaluation in the diagnostic workup.

c. Post-inflammatory Melanonychia

Post-inflammatory melanonychia, observed in 7.1% of nails, was primarily associated with **psoriasis** and **lichen planus**. Most of these cases involved fingernails, with a predominance of homogeneous or subtly irregular longitudinal bands. Dermoscopy revealed additional disease-specific clues—such as nail pitting or longitudinal ridging—supporting the inflammatory origin. These findings are consistent with Piraccini et al.,[47] who emphasized that post-inflammatory pigmentation may present subtly, often requiring dermoscopy to shows other specific signs of the diseases, allowing the diagnosis.

d. Traumatic Melanonychia

Frictional and post-traumatic melanonychia, representing 2.4% and 1.9% respectively, were less frequent but notable for their monodactylic presentation and the absence of concerning dermoscopic signs such as Hutchinson's sign or marked irregularity. These benign entities often mimic more worrisome lesions but were distinguishable through their regular dermoscopic architecture and clinical context, as outlined in prior reviews.[2,6] Our findings reinforce the importance of considering mechanical and

occupational factors, especially in cases involving overlapping toes, tight footwear, or nail-biting.

e. Non-melanoma Nail Tumors-related Melanonychia

Non-melanoma nail tumors, though relatively rare, were identified in our cohort and included onychopapilloma (n=8), onychomatricoma (n=2), and a single case of glomus tumor. These entities can clinically and dermoscopically mimic melanonychia, underscoring the importance of including them in the differential diagnosis, particularly when features are atypical or pigmentation is accompanied by nail plate distortion.[2]

Onychopapilloma, the most common benign nail tumor in our series, often presents with longitudinal erythronychia or melanonychia, and may be associated with subungual hyperkeratosis or distal fissuring. In melanonychia-mimicking cases, pigmentation is typically localized and may appear streaked or splintered at the free edge.[50,51]

Onychomatricoma, though less common, is known for its characteristic "woodworm-like" thickening of the nail plate and yellowish discoloration. When melanonychia is present, it usually results from melanin trapped within the thickened nail due to matrix overgrowth. Dermoscopy may reveal splinter hemorrhages or cavities in the distal nail plate.[51]

The glomus tumor, classically painful and often subungual, may also rarely present with pigmentation due to vascular congestion or hemorrhage.

While dermoscopic features are not specific, associated findings such as bluish discoloration or nail plate distortion should raise suspicion.[2,33]

Accurate diagnosis of these tumors requires a combination of clinical suspicion, dermoscopic evaluation, and, in most cases, histopathological confirmation. Their recognition is critical, as surgical excision is often curative and delays in diagnosis may result in persistent symptoms or progressive nail damage.

2. Melanocytic Proliferation

a. Nail Apparatus melanoma

Melanocytic proliferations significantly contributed to melanonychia, particularly NAM, NMN, and lentigo. **Subungual melanoma** accounted for 1.3% of our total sample—comparable to earlier hospital-based series[36,39]—but carried the gravest prognostic implications. All confirmed melanoma cases displayed a characteristic combination of irregular parallel lines, multicolored pigmentation, and sometimes black granules, findings that are consistent with established dermoscopic criteria for malignancy.[1,3] These bands were also consistently rectangular in shape and demonstrated three or more line colors, further reinforcing their atypical nature.[17]

Hutchinson's sign was universally present in NAM cases, resulting from pigment extension onto the lateral folds or hyponychium—but notably, without true invasion of the eponychium or cuticle. This underlines the importance of precise dermoscopic inspection to differentiate true extension

from subcuticular transparency.[3,22,24] Additionally, full-thickness pigmentation of the nail plate, observed in 71.4% of cases, served as another key indicator of malignancy and may reflect diffuse melanocyte proliferation across both the proximal and distal matrix.[2]

b. Nail Matrix Melanoma

Our findings allowed for a detailed assessment of both congenital and acquired nail matrix nevi (NMN), highlighting distinct dermoscopic and clinical profiles that may aid in differential diagnosis.

Congenital NMNs, observed in 6 nails (one of which was excluded due to concurrent subungual melanoma), were marked by a high rate of irregular dermoscopic patterns, present in approximately 80% of cases. These irregularities involved disruptions in line width, spacing, or parallelism, despite the overall rectangular shape and homogeneous background seen in all cases. Most lesions displayed brown to dark brown pigmentation, with a single lesion appearing black. Pseudo-Hutchinson's sign was observed in 100% of congenital nevi, while free edge dermoscopy revealed proximal matrix involvement in half the cases and full-thickness nail plate pigmentation in a third. These findings suggest that congenital NMNs, though benign, may display multiple features that overlap with criteria traditionally associated with atypia or malignancy.[2,17] This aligns with pediatric dermoscopy literature emphasizing the frequent presence of "alarming" features in congenital nevi that remain histologically benign.[34,35]

In contrast, **acquired NMNs** (6 cases) exhibited greater variability in clinical and dermoscopic presentation. Black pigmentation was predominant (66.7%), followed by brown (33.3%). While two-thirds maintained a rectangular band shape, the remainder were triangular, a morphology more commonly associated with concerning lesions.[17,22] Dermoscopically, regular patterns were observed in half the cases, with most respecting parallelism and regular line thickness, though spacing was only regular in about 50%. A homogeneous background was seen in most cases, while some exhibited a heterogeneous background. Periungual signs were more diverse: Hutchinson's sign was present in 33.3%, pseudo-Hutchinson's in 50%, and micro-Hutchinson's in 16.7%. The presence of black lines in two-thirds of cases also deserves attention, as this feature is rarely emphasized in benign nevi but emerged in our cohort as a notable component of acquired NMN pigmentation.

Taken together, these results reinforce the importance of individualized assessment of NMNs. Congenital NMNs, while frequently showing multiple atypical features, tend to follow a benign clinical course. In contrast, acquired NMNs, though more likely to show features traditionally considered regular, can still present with darker pigmentation and focal atypia. This emphasizes the need for careful pattern analysis rather than reliance on isolated features for risk stratification.[34,35]

c. Nail Lentigo

Lentigo was a relatively uncommon etiology in our cohort, identified in only 1.8% of affected nails. However, its presentation was remarkably

consistent, with all cases exhibiting homogeneous gray to light brown pigmentation and regular dermoscopic lines. These findings are in line with those reported by Bertanha et al.,[2] who described nail matrix lentigines as subtle, stable lesions that typically lack the dermoscopic atypia associated with nevi or melanoma.

In our series, no cases of lentigo demonstrated periungual pigmentation or irregular band morphology, further supporting its benign clinical and dermoscopic profile.[17,36] Nevertheless, the overlap in presentation with early-stage nevi, particularly in cases with fine gray lines or pseudo-gray patterns, highlights the diagnostic difficulty in distinguishing lentigo from other melanocytic proliferations based solely on non-invasive assessment. This underscores the value of histopathological confirmation in ambiguous cases, especially when clinical evolution or patient history raises concern.[29]

3. Non-Melanocytic Melanonychia

Among **non-melanocytic causes**, **fungal melanonychia** was the second most frequent etiology overall (25%). The association with onychodystrophy, onycholysis, and subungual hyperkeratosis was strong and statistically significant, consistent with previous descriptions.[2,11,44] Our identification of *Trichophyton rubrum* as the dominant pathogen also aligns with established epidemiology. The high frequency of polydactylic involvement and grayish or yellowish hues provide important clues for differentiation from melanocytic lesions.

Subungual hemorrhages, though infrequent, showed characteristic features such as distal localization, granular pattern, and splinter hemorrhages. These findings echo diagnostic dermoscopic hallmarks delineated in prior literature,[17,47] helping distinguish them from neoplastic bands.

Finally, our cohort did not yield any confirmed cases of melanonychia due to **systemic diseases**, such as Addison's disease or Laugier-Hunziker syndrome, which are more commonly reported in internal medicine or endocrinology settings.[47] This absence may reflect referral patterns or demographic differences in our patient population.

IV. Diagnostic Pitfalls and Strategic Approach

Despite the value of dermoscopy in characterizing melanonychia, our experience highlighted several diagnostic challenges. A notable proportion of nevi—particularly congenital and some acquired forms—demonstrated irregular features, such as variation in line thickness and spacing, presence of heterogeneous background pigmentation, as well as hutchinson's sign despite histopathological confirmation of benignity.

Conversely, all histologically confirmed NAM cases in our cohort exhibited classic irregular dermoscopic patterns, including multicolored lines (brown, black, gray), asymmetry, and loss of parallelism—features aligned with established malignancy criteria.[4,5,34,36] These lesions also frequently showed true Hutchinson's sign, micro-Hutchinson's sign, or a parallel ridge pattern on

the hyponychium, reinforcing their diagnostic value.[4,5,22,24] Importantly, in all melanoma cases, Hutchinson's sign resulted from extension of pigment to the lateral nail fold or the hyponychium. Notably, none demonstrated actual invasion of the eponychium or cuticle. In these instances, pigment was visible beneath the translucent cuticle, which could be mistaken for involvement, emphasizing the importance of meticulous inspection to differentiate between true extension and pigment transparency.

Despite these classic dermoscopic clues, a critical observation emerged: several NAM cases exhibited only minor irregularities within the nail plate itself—limited asymmetry or subtle color variation that, isolated, may not have triggered immediate biopsy under conventional dermoscopic algorithms. What ultimately raised suspicion in these cases was the presence of periungual pigmentation—an external, more conspicuous indicator that decisively influenced management. This raises a key concern regarding potential underdiagnosis of early-stage NAMs when relying solely on nail plate features, and points to a need for revisiting existing dermoscopic thresholds in subtle cases.

In refining our diagnostic process, we adopted a risk-adapted management approach: congenital nevi, even when atypical, were closely monitored over time with serial dermoscopic imaging due to the extremely low risk of malignant transformation reported in the literature.[35] while acquired nevi in adults that displayed any concerning features were biopsied for histological confirmation to exclude melanoma. This approach is supported by current guidelines, which emphasize that any new pigmented nail band

appearing after the fourth decade of life—especially if solitary or evolving—should raise suspicion for melanoma.[4,5,22,39]

Furthermore, onychoscopy helped differentiate melanonychia from non-melanocytic causes such as fungal melanonychia, which may present as pigmented, irregularly distributed amorphous patches without the typical parallel lines of melanocytic lesions.[20,38] In drug-induced melanonychia, pigmentation was typically gray-brown, with variations including gray, brown, black, or gray-blue. The involvement was predominantly polydactylic, and most cases presented with longitudinal bands. However, a small subset exhibited transverse alternating pigmented and non-pigmented bands. This pattern may be attributed to intermittent drug administration, where treatment cycles produce alternating phases of melanin activation and rest, leading to banding across the nail plate, as previously described.[19,31,32]

The integration of dermoscopic features with clinical data—including age, phototype, number of involved nails, evolution over time, and history of trauma or drug exposure—proved invaluable in establishing a diagnostic pathway. Tools such as the “Seven Plus One” algorithm developed by Lallas et al.[4] and dermoscopic checklists proposed by Thomas et al.[24] and Starace et al.[1] facilitated structured assessment and clinical decision-making. This approach minimized unnecessary biopsies while ensuring early detection of suspicious lesions.

These findings highlight the need for a comprehensive, context-sensitive approach to melanonychia—one that integrates dermoscopic analysis

with clinical judgment, especially in patients with darker phototypes, where benign features can mimic early malignancy. In settings where biopsy access is limited or deferred, the ability to detect subtle warning signs—such as periungual pigmentation or free edge changes—without overdiagnosing benign lesions becomes essential. Our results show that no single dermoscopic or clinical criterion is sufficient in isolation. Instead, a composite, risk-adapted strategy—grounded in both pattern recognition and patient context—offers a more reliable diagnostic framework. By refining thresholds for concern and emphasizing the importance of subtle yet significant clues beyond the nail plate, this approach enhances early melanoma detection while minimizing unnecessary interventions. It offers a practical, adaptable model for clinicians navigating the diagnostic challenges of melanonychia in both general and specialized dermatology practice.

STUDY LIMITATIONS

Despite its comprehensive approach, this study presents several limitations that should be acknowledged. First, the cross-sectional and retrospective nature of the data introduces potential biases, including recall bias from patient-reported histories (e.g., trauma, drug intake, familial cases) and selection bias due to the hospital-based recruitment. As a result, the prevalence rates of certain etiologies—especially rarer systemic or occupational causes—may not be fully representative of the general population.

Second, while histopathological confirmation was obtained in all suspicious cases and many melanocytic proliferations, benign lesions—particularly in ethnic or drug-induced melanonychia—were often diagnosed clinically and dermoscopically without biopsy, in line with standard practice. This may have led to underdiagnosis or misclassification in ambiguous cases, although conservative management was ethically and clinically appropriate.

Lastly, the relatively small number of malignant lesions (NAM) and less common entities like lentigo or post-traumatic melanonychia limited the statistical power for subgroup comparisons. Although meaningful patterns were still identified, these findings should be interpreted cautiously and validated in larger multicentric studies.

STUDY STRENGTHS

Despite these limitations, this study offers several notable strengths. Most importantly, it represents one of the largest single-center analyses of melanonychia to date, with 160 patients and 548 affected nails systematically examined. The size and depth of this cohort allowed for robust statistical analyses across a wide range of etiologies, age groups, and clinical presentations.

Second, the study incorporated a dermoscopic examination of both the nail plate and the free edge—a rarely documented aspect in the literature—which added diagnostic precision, particularly in differentiating the origin of pigmentation within the nail matrix. This multidimensional approach strengthens the diagnostic framework and may improve clinical decision-making in future practice.

Third, the study population's diversity in skin phototypes—especially the predominance of Fitzpatrick IV and V—provides valuable insights into melanonychia in populations that are often underrepresented in dermatologic research. This is particularly relevant in differentiating ethnic melanonychia from early melanoma and contributes to more globally applicable diagnostic criteria.

Furthermore, the inclusion of both pediatric and adult patients enabled meaningful comparisons between congenital and acquired nail matrix nevi,

offering rare data that supports the development of age-stratified dermoscopic markers.

Finally, the integration of clinical, dermoscopic, microbiological, and histological data in a unified framework allowed for a more nuanced and accurate etiological classification. This comprehensive design enhances both the diagnostic and educational value of the study, making it a strong reference point for clinicians managing longitudinal melanonychia.

CONCLUSION

Melanonychia encompasses a broad and heterogeneous spectrum of conditions, ranging from benign melanocytic lesions to serious malignant entities. Through a comprehensive study of 160 patients and 548 affected nails, we were able to provide detailed insight into the epidemiological, clinical, and dermoscopic characteristics of melanonychia in a Moroccan population.

This study achieved its primary objectives by thoroughly describing the dermoscopic patterns observed across the diverse etiologies of melanonychia. Through systematic comparison, we identified key distinguishing features across diagnostic categories—such as polychromatic gray bands in melanocytic activation, multicolor irregular patterns in melanocytic neoplasms, and granular pigmentation in subungual hemorrhages. These observations allowed for meaningful differentiation between various causes and helped clarify overlaps in challenging cases.

Furthermore, the diagnostic value of dermoscopy in differentiating benign from malignant melanonychia was affirmed, fulfilling our secondary objective. Malignancies were consistently associated with specific dermoscopic hallmarks—particularly multicolored pigmentation, black granular dots, Hutchinson's sign, and full-thickness pigmentation—thereby reinforcing the role of dermoscopy as a critical, non-invasive triage tool for biopsy decision-making.

Overall, the study adds to the growing body of literature emphasizing a multimodal approach—combining dermoscopy, clinical context, and histopathological confirmation when indicated—as essential in the accurate assessment of longitudinal melanonychia. The findings underscore the need for continued refinement of dermoscopic criteria, particularly in populations with darker phototypes where benign melanonychia is common yet diagnostic ambiguity persists.

ANNEXE 1

Fiche d'exploitation

1. Informations générales

- Nom du patient :
- Ip :
- Âge :
- Sexe :
- Phototype :
- Profession :

2. Antécédents médicaux

- Personnels :
  - Dermatologiques (mélanome, nævus atypiques, etc.) :
  - Systémiques (pathologies auto-immunes, endocriniennes, etc.) :
- Familiaux :
  - Antécédents de mélanome ou de cancers cutanés :
  - Cas similaires dans la famille

3. Données cliniques

- Présence de mélanoses éthniques (pp, muqueuse…) : oui non
- Age d'apparition :

- Si post médicamenteuse : délai entre la prise médicamenteuse et l'apparition :
- Nombre d'ongles atteints : 1 2 3 >3
- Doigts Orteils les deux
- Si monodactylique/paucidactylique, quel doigt ou orteil concerné :
- **Mélanonychie :** totale longitudinale transverse
- Caractéristiques cliniques de la bande pigmentée :
    - **Couleur** : Brun foncé brun clair Noir Gris hétérogène autres
    - **Couleur :** homogène hétérogène
    - Largeur (Si longitudinale) : <1/3 1/3-2/3 >2/3
    - **Localisation (si transversale) :** distale, proximale, totale, autres
    - **Bords lateraux:** (nets ou flous)
- Signes associés :
    - Fissuration, onycholyse, ou dystrophie, hyperkératose sous unguéale, pachyonychie, autres
    - Signe de Hutchinson
    - Symptômes locaux : douleur, inflammation
- Caractéristiques dermoscopiques
    - **Fond :** homogène Hétérogène
    - Couleur du fond
    - **Couleur sous DSC :** Brun foncé brun clair Noir Gris rouge autres
    - Unicolor Multicolor

- Symetrie : Symétrique asymétrique
- Éclaircissement sous DSC : oui non
- **Couleur des stries :** noir brun foncé brun claire gris hétérogène
- **Taille des stries**: régulier Irrégulier
- Espacement des stries : régulier Irrégulier
- Parallélisme des stries : régulier Irrégulier
- Patron : régulier irrégulier
- Patron vasculaire :
- Présence d'autres signes : points, globules, longitudinal microscopic grooves, border fading triangular sign
- Hutchinson : micro-Hutchinson Pseudo-Hutchinson
- Autres :

4. Facteurs de risque

- **Traumatiques** : Microtraumatismes répétés (sport, instrument de musique, etc.)
- **Professionnels** :Exposition à des substances chimiques ou radiations
- Médicaments :
- Inflammation chronique

6. Diagnostic retenu

7. Investigations complémentaires (si nécessaires)

ABSTRACT

Background:

Melanonychia, defined as pigmentation of the nail plate due to melanin or other pigments, is a frequent but diagnostically challenging presentation in dermatology. It may result from benign melanocytic activation, melanocytic proliferations such as nevi or melanoma, or non-melanocytic causes like infections or trauma. Early distinction between benign and malignant etiologies is critical, particularly for subungual melanoma, which has a poor prognosis if diagnosed late.

Objectives:

To evaluate the clinical and dermoscopic characteristics of melanonychia across various etiologies, and to identify dermoscopic features with diagnostic relevance for distinguishing benign from malignant causes.

Methods:

A retro-prospective observational study was conducted at the Dermatology Department of CHU Hassan II, involving 160 patients and 548 nails affected by melanonychia. Data collected included demographic variables, clinical features, dermoscopic findings, and, when applicable, histopathologic or mycological results. Dermoscopic features such as band color, pattern regularity, pigment distribution, and presence of Hutchinson's sign were assessed. Statistical analysis was performed using SPSS, with chi-square tests and p-values < 0.05 considered significant.

Results:

The study population had a mean age of 50.18 years, with a female predominance (60%). Most patients had Fitzpatrick phototype IV. Longitudinal melanonychia was the most prevalent pattern, observed in 83.4% of affected nails, frequently involving the thumbs and great toes. Polydactylic melanonychia was present in over half the cohort (51.9%), particularly in cases attributed to racial pigmentation and drug-induced melanonychia. Dermoscopically, benign forms—such as racial, drug-induced, or post-inflammatory melanonychia—most commonly displayed gray to gray-brown homogeneous bands with regular parallel lines and lacked Hutchinson's sign. In contrast, subungual melanomas, histologically confirmed in 7 nails (1.3%), were significantly associated with multicolored pigmentation, black dermoscopic lines, irregularity in line thickness and spacing, granular pigmentation, and true Hutchinson's sign, with all features reaching statistical significance ($p < 0.001$).

Fungal melanonychia, the second most common etiology (25%), was characterized by gray or yellow pigmentation in association with onychodystrophy, onycholysis, and subungual hyperkeratosis. Nail matrix nevi, whether acquired or congenital, demonstrated regular or irregular parallel line patterns depending on the subtype; congenital nevi tended to exhibit greater irregularity but less pigment depth. Drug-induced melanonychia affected 127 nails and was marked by multicolor pigmentation in 18.1% of cases, with over one-third showing discrepancies between clinical and dermoscopic color impressions. Free edge dermoscopy proved

diagnostically useful: pigment restricted to the lower portion of the nail plate was frequently associated with benign melanocytic activation, while full-thickness pigmentation patterns were more commonly observed in melanoma and drug-induced cases.

Statistical analysis revealed significant associations between band shape and underlying etiology ($p = 0.015$), band color and etiology ($p = 0.034$), free edge pigmentation and etiology ($p < 0.001$), and the number of dermoscopic colors and etiology ($p = 0.011$). Multicolor patterns were more frequently linked to melanoma, inflammatory conditions, and drug reactions. Discrepancies between clinical and dermoscopic pigmentation were also statistically significant ($p = 0.019$), especially in exogenous and drug-induced cases. Although Hutchinson's sign was universally present in melanoma cases, it did not reach overall statistical significance across all etiologies due to its absence in benign conditions.

Conclusion:

Dermoscopic evaluation significantly enhances diagnostic accuracy in melanonychia by revealing subtle features that differentiate benign from malignant conditions. This study highlights key dermoscopic markers—particularly multicolor pigmentation, irregular line patterns, and Hutchinson's sign—as critical red flags for melanoma. A structured dermoscopic approach, integrated with clinical context, supports earlier recognition of malignancy, minimizes unnecessary biopsies, and improves decision-making in the management of nail pigmentation disorders.

RESUME

Introduction :

La mélanonychie, définie comme une pigmentation brune à noire de la lame unguéale, est une présentation fréquente mais difficile sur le plan diagnostique en dermatologie. Elle peut résulter d'une activation mélanocytaire bénigne, d'une prolifération mélanocytaire telle qu'un nævus ou un mélanome, ou de causes non mélanocytaires comme les infections ou les traumatismes. Une distinction précoce entre les étiologies bénignes et malignes est cruciale, notamment pour détecter le mélanome sous-unguéal, dont le pronostic est sombre en cas de diagnostic tardif.

Objectifs:

Décrire les caractéristiques cliniques et dermoscopiques des mélanonychies selon les différentes étiologies, et identifier les éléments dermoscopiques pertinents permettant de différencier les causes bénignes des causes malignes.

Méthodes :

Une étude observationnelle rétro-prospective a été menée au service de dermatologie du CHU Hassan II, incluant 160 patients présentant au total 548 ongles atteints de mélanonychie. Les données collectées comprenaient les variables démographiques, les caractéristiques cliniques, les aspects dermoscopiques, et, lorsque nécessaire, les résultats histopathologiques ou mycologiques. L'analyse dermoscopique portait sur des éléments tels que la

couleur, la régularité des bandes, la distribution du pigment, et la présence du signe de Hutchinson. Les analyses statistiques ont été réalisées avec SPSS ; un $p < 0,05$ a été considéré comme significatif.

Résultats :

L'âge moyen des patients était de 50,18 ans, avec une prédominance féminine (60 %). La majorité des patients avaient un phototype IV selon Fitzpatrick. Le type longitudinal représentait la forme la plus fréquente de mélanonychie (83,4 %), touchant principalement les pouces et les gros orteils. Une atteinte polydactylique était observée chez 51,9 % des patients, notamment dans les cas de mélanonychie ethnique et médicamenteuse. Sur le plan dermoscopique, les mélanonychies bénignes (ethniques, médicamenteuses ou post-inflammatoires) présentaient majoritairement des bandes grises ou brun-gris homogènes, avec des lignes parallèles régulières et sans signe de Hutchinson. À l'inverse, les mélanomes sous-unguéaux, confirmés histologiquement dans 7 cas (1,3 %), étaient significativement associés à une pigmentation multicolore, des lignes noires dermoscopiques, une irrégularité de l'épaisseur et de l'espacement des lignes, une pigmentation granuleuse, et à un véritable signe de Hutchinson, tous statistiquement significatifs ($p < 0,001$).

La mélanonychie fongique, deuxième cause la plus fréquente (25 %), était caractérisée par une pigmentation grise ou jaunâtre, associée à une onychodystrophie, une onycholyse et une hyperkératose sous-unguéale. Les nævus du lit matriciel, acquis ou congénitaux, présentaient des lignes

parallèles régulières ou irrégulières selon le type ; les nævus congénitaux se caractérisaient par une plus grande irrégularité, mais une pigmentation moins intense. La mélanonychie induite par les médicaments (127 ongles) montrait des bandes multicolores dans 18,1 % des cas, avec des écarts de perception de couleur entre l'examen clinique et la dermoscopie dans plus d'un tiers des cas. L'examen de l'extrémité libre de l'ongle s'est révélé particulièrement informatif : une pigmentation localisée dans la partie inférieure de la plaque unguéale était fréquemment observée dans les cas bénins, tandis qu'une pigmentation diffuse sur toute l'épaisseur de la plaque était davantage associée aux mélanomes ou aux causes médicamenteuses.

L'analyse statistique a mis en évidence des associations significatives entre la forme de la bande et l'étiologie ($p = 0,015$), la couleur de la bande et l'étiologie ($p = 0,034$), la distribution du pigment en coupe libre et l'étiologie ($p < 0,001$), ainsi qu'entre le nombre de couleurs observées en dermoscopie et l'étiologie ($p = 0,011$). Les motifs multicolores étaient plus fréquents dans les mélanomes, les atteintes inflammatoires, et les causes médicamenteuses. Les différences entre les couleurs perçues cliniquement et celles observées en dermoscopie étaient aussi significatives ($p = 0,019$), notamment dans les cas de pigmentation exogène et médicamenteuse. Bien que le signe de Hutchinson ait été universellement retrouvé dans les cas de mélanome, il n'a pas atteint une significativité statistique globale du fait de son absence dans les formes bénignes.

Conclusion :

La dermoscopie améliore considérablement la précision diagnostique dans l'évaluation des mélanonychies, en révélant des critères subtils mais essentiels pour différencier les causes bénignes des entités malignes. Cette étude met en évidence certains marqueurs dermoscopiques clés—tels que la pigmentation multicolore, l'irrégularité des lignes et la présence du signe de Hutchinson—comme des signes d'alerte majeurs du mélanome. Une approche dermoscopique structurée, intégrée au contexte clinique, permet un repérage précoce des cas à risque, limite les biopsies inutiles, et améliore la prise en charge diagnostique des pigmentations unguéales.

ملخص

مقدمة:

تُعرف الميلانونيشيا بأنها تصبغ بني أو أسود في صفيحة الظفر، وقد تنجم عن تنشيط خلايا الميلانين بشكل حميد، أو عن تكاثرها كما في حالات الوحمات أو الميلانوما، أو عن أسباب غير ميلانينية مثل داء الفطار الظفري أو الرضوض. يُعد التمييز المبكر بين الأسباب الحميدة والخبيثة أمرًا بالغ الأهمية، لا سيما في حالات الميلانوما تحت الظفر، وهي نادرة لكنها عدوانية، وتتطلب تشخيصًا مبكرًا لتحسين الإنذار.

الأهداف:

دراسة الخصائص السريرية والدرموسكوبية للميلانونيشيا بمختلف مسبباتها، وتحديد السمات التي تساعد في التمييز بين الآفات الحميدة والخبيثة.

المنهجية:

أُجريت دراسة رصدية استعادية واستباقية في مصلحة الأمراض الجلدية بالمركز الاستشفائي الجامعي الحسن الثاني، شملت 160 مريضًا و548 ظفرًا مصابًا بالميلانونيشيا. تم جمع المعطيات السريرية والديموغرافية والدرموسكوبية، إضافة إلى الفحوصات المخبرية أو الخزعات عند الاقتضاء. شمل التقييم الدرموسكوبي عناصر مثل لون الحزمة، انتظام الخطوط، توزيع الصبغة، ووجود علامة هتشينسون. أُجري التحليل الإحصائي باستخدام برنامجSPSS ، مع اعتماد قيمة دلالة $p < 0.05$.

النتائج:

كان متوسط عمر المرضى 50.18 سنة، مع غلبة للإناث (60%). أغلب المرضى كانوا من أصحاب الفوتوتايب الرابع. كانت الميلانونيشيا الطولية الشكل الأكثر شيوعًا (83.4%)، خاصة في الإبهام والإصبع الكبير للقدم. سُجّلت إصابة متعددة الأصابع في 51.9% من الحالات، خصوصًا في الميلانونيشيا العرقية والدوائية.

أظهرت الحالات الحميدة أنماطًا درموسكوبية متجانسة، بخطوط رمادية أو بنية رمادية منتظمة، وغياب علامة هتشينسون. أما الميلانوما تحت الظفر (7 حالات مؤكدة؛ 1.3%)، فتميّزت بعدة خصائص مهمة: تصبغ متعدد الألوان، وجود خطوط سوداء، عدم انتظام في سمك وتباعد الخطوط، صبغة حبيبية، وعلامة هتشينسون الحقيقية، جميعها ذات دلالة إحصائية عالية.($p < 0.001$)

سُجّلت الميلانونيشيا الفطرية كثاني أكثر الأسباب شيوعًا (25%)، وارتبطت بتغيرات مثل الحثل، الانفصال الظفري، وفرط التقرن تحت الظفر. أما الوحمات الظفرية (مكتسبة أو خلقية)، فقد أظهرت خطوطًا موازية منتظمة أو غير منتظمة حسب النمط، فيما أظهرت الميلانونيشيا الدوائية (127 ظفرًا) تعددًا لونيًا في 18.1% من الحالات، مع اختلاف ملحوظ بين اللون السريري والدرموسكوبي في أكثر من ثلث الحالات.

أظهر فحص الحافة الحرة للظفر أهمية تشخيصية، إذ ارتبطت الصبغة المحصورة في الجزء السفلي بالحالات الحميدة، بينما ارتبط التصبغ بكامل سمك الظفر بالميلانوما أو بالأسباب الدوائية. أظهرت التحليلات الإحصائية روابط دالة بين شكل الحزمة والمسبب($p = 0.015$) ، لون الحزمة($p = 0.034$) ، نمط التصبغ على الحافة الحرة ($p < 0.001$)، وعدد الألوان الدرموسكوبية .($p = 0.011$) كما كان التفاوت بين اللون السريري والدرموسكوبي دالًا إحصائيًا($p = 0.019$) ، خصوصًا في الحالات الدوائية والخارجية المنشأ. ورغم أن علامة هتشينسون كانت موجودة في جميع حالات الميلانوما، إلا أنها لم تكن دالة إحصائيًا عند تحليل جميع الأسباب نظرًا لندرتها في الحالات الحميدة.

الخلاصة:

تُعد الدرموسكوبيا أداة أساسية في تقييم الميلانونيشيا، حيث تتيح تمييزًا أفضل بين الحالات الحميدة والخبيثة من خلال مؤشرات مثل التصبغ المتعدد، عدم انتظام الخطوط، ووجود علامة هتشينسون. يعزز هذا التقييم المنهجي التشخيص المبكر، يقلل من اللجوء إلى الخزعات غير الضرورية، ويساهم في تحسين جودة الرعاية السريرية.

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