

## REVIEW

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# Evaluation of nail lines: Color and shape hold clues

## ABSTRACT

Nail lines are a common presenting finding. A thorough inspection of the fingernails and toenails is an integral part of the complete physical examination. An understanding of basic nail anatomy and familiarity with several basic types of nail line enable the clinician to diagnose and treat nail disorders and to recognize underlying systemic diseases, as each type of nail line has a particular differential diagnosis. The authors review leukonychia striata (white lines), longitudinal melanonychia (brown-black lines), longitudinal erythronychia (red lines), and nail-plate grooves (Beau lines).

## KEY POINTS

Transverse white nail lines, or Mees lines, have been associated with acute systemic stress, such as from acute renal failure, heart failure, ulcerative colitis, breast cancer, infection (measles, tuberculosis), and systemic lupus erythematosus, and with exposure to toxic metals such as thallium.

In true leukonychia, there is abnormal keratinization of the underlying nail matrix, resulting in a white discoloration that is unaffected by pressure. In apparent leukonychia, the white discoloration is due to abnormal nail bed vasculature, and the whiteness disappears with pressure.

Brown-black nail lines may represent blood from trauma; bacterial, fungal, or viral infection; drug reaction; endocrine disorders; exogenous pigmentation; excess melanin production within the nail matrix; nevi; or melanoma.

**I**NSPECTION OF THE FINGERNAILS and toenails should be part of a complete physical examination. A basic understanding of nail anatomy and recognition of several basic types of nail lines and bands allow the clinician to properly diagnose and treat the nail disease, to recognize possible underlying systemic diseases, and to know when to refer the patient to a dermatologist for specialized evaluation and biopsy.

In this review, we delineate the three basic types of nail lines—white lines (leukonychia striata), brown-black lines (longitudinal melanonychia), and red lines (longitudinal erythronychia)—and the differential diagnosis for each type. We also discuss grooves in the nail plate, or Beau lines.

## ■ BASIC NAIL ANATOMY

A fundamental understanding of the anatomy of the nail unit is necessary to understand the origin of nail diseases and underlying pathologic conditions.

The nail unit includes the nail matrix, the lunula, the nail fold, the nail plate, and the nail bed. The nail matrix extends from under the proximal nail fold to the half-moon-shaped area (ie, the lunula) and is responsible for nail plate production. The nail bed lies under the nail plate and on top of the distal phalanx and extends from the lunula to just proximal to the free edge of the nail; its rich blood supply gives it its reddish color.

Nails grow slowly, and this should be kept in mind during the examination. Regrowth of a fingernail takes at least 6 months, and regrowth of a toenail may take 12 to 18 months. Therefore, a defect in the nail plate may reveal an injury that occurred—or a condition that began—several months before.<sup>1</sup>

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**FIGURE 1.** Onychomycosis of the great toenail resulting in a dermatophytoma, visible as a white-yellow longitudinal band.



**FIGURE 2.** “Half-and-half” nails involve a transverse white band proximally and a red-brown band distally. Underlying conditions include Kawasaki disease, cirrhosis, Crohn disease, and zinc deficiency.

**Onychomycosis causes white nail lines and accounts for half of all cases of nail disease**

■ **NAIL EXAMINATION ESSENTIALS**

A complete examination includes all 20 nail units and the periungual skin. Patients should be instructed to remove nail polish from all nails, as it may camouflage dystrophy or disease of the nail. Photography and careful measurement help document changes over time.

■ **LEUKONYCHIA STRIATA: WHITE NAIL LINES**

White nail lines or leukonychia is classified as true or apparent, depending on whether the origin is in the nail matrix or the nail bed.

In true leukonychia, there is abnormal keratinization of the underlying nail matrix, resulting in parakeratosis within the nail plate and an opaque appearance on examination.<sup>2</sup> The white discoloration is unaffected by pressure, and the opacity moves distally as the nail grows out, which can be documented by serial photography on subsequent visits.

Apparent leukonychia involves abnormal nail bed vasculature, which changes the translucency of the nail plate. The whiteness disappears with pressure, is unaffected by nail growth, and will likely show no change on later visits with serial photography.<sup>3</sup>

**True leukonychia**

Leukonychia striata, a subtype of true leukonychia, is characterized by transverse or longitudinal bands. It is most often associated with microtrauma, such as from a manicure.<sup>4</sup> Lines due to trauma are typically more apparent in the central part of the nail plate; they spare the lateral portion and lie parallel to the edge of the proximal nail fold.<sup>5</sup>

**Onychomycosis.** White longitudinal bands may also be seen in onychomycosis, a fungal infection of the nail accounting for up to 50% of all cases of nail disease. The infection may present as irregular dense longitudinal white or yellowish bands or “spikes” on the nail plate with associated hyperkeratosis, known as a dermatophytoma (**Figure 1**).

If a fungal infection is suspected, a potassium hydroxide stain can be performed on the subungual debris, which is then examined with direct microscopy.<sup>6</sup> Alternatively, the physician can send a nail plate clipping in a 10% buffered formalin container with a request for a fungal stain such as periodic acid-Schiff.<sup>7</sup> Microscopic examination of a dermatophytoma shows a dense mass of dermatophyte hyphae, otherwise known as a fungal abscess.<sup>8</sup>

The physician can play an important role in diagnosis because clinical findings suggestive of a dermatophytoma are associated with

a poor response to antifungal therapy.<sup>9</sup>

**Inherited diseases.** White longitudinal bands are also an important clue to the rare autosomal dominant genodermatoses Hailey-Hailey disease (from mutations of the *ATP2A2* gene) and Darier disease (from mutations of the *ATP2C1* gene). Patients with Hailey-Hailey disease may have nails with multiple parallel longitudinal white stripes of variable width originating in the lunula and most prominent on the thumbs.<sup>10-12</sup> These patients also have recurrent vesicular eruptions in flexural skin areas, such as the groin, axilla, neck, and periumbilical area causing significant morbidity.

Patients with Darier disease may have nails with alternating red and white longitudinal streaks, described as “candy-cane,”<sup>13</sup> as well as wedge-shaped distal subungual keratosis accompanied by flat keratotic papules on the proximal nail fold.<sup>14</sup> These nail changes are reported in 92% to 95% of patients with Darier disease.<sup>15,16</sup> Patients typically have skin findings characterized by keratotic papules and plaques predominantly in seborrheic areas and palmoplantar pits, as well as secondary infections and malodor causing significant morbidity.<sup>15</sup> Therefore, knowing the characteristic nail findings in these diseases may lead to more rapid diagnosis and treatment.

**Mees lines.** Leukonychia striata can present as transverse white lines, commonly known as Mees lines. They are 1- to 2-mm wide horizontal parallel white bands that span the width of the nail plate, usually affecting all fingernails.<sup>17</sup> They are not a common finding and are most often associated with arsenic poisoning. They can also be used to identify the time of poisoning, since they tend to appear 2 months after the initial insult.

Mees lines are also associated with acute systemic stresses, such as acute renal failure, heart failure, ulcerative colitis, breast cancer, infections such as measles and tuberculosis, and systemic lupus erythematosus, and with exposure to toxic metals such as thallium.<sup>3</sup>

### Apparent leukonychia

Apparent leukonychia can alert the physician to systemic diseases, infections, drug side effects, and nutrient deficiencies. Specific nail findings include Muehrcke lines, “half-and-half” nails, and Terry nails.



**FIGURE 3.** Longitudinal melanonychia presents as one or more longitudinal brown-black bands in the nail plate. Underlying conditions include melanoma in situ (A) and benign nevus (B).

**Muehrcke lines** are paired white transverse bands that span the width of the nail bed and run parallel to the distal lunula. They were first described in the fingernails of patients with severe hypoalbuminemia, some of whom also had nephrotic syndrome, which resolved with normalization of the serum albumin level. Muehrcke lines have since been reported in patients with liver disease, malnutrition, chemotherapy, organ transplant, human immunodeficiency virus (HIV) infection, and acquired immunodeficiency syndrome.<sup>3,18</sup> They are associated with periods of metabolic stress, ie, when the body’s capacity to synthesize proteins is diminished.<sup>19</sup>

**Half-and-half nails**, or Lindsay nails, are characterized by a white band proximally, a pink or red-brown band distally, and a sharp demarcation between the two (Figure 2). They were originally described in association with chronic renal disease,<sup>20</sup> and surprisingly, they resolve with kidney transplant but not with hemodialysis treatment or improvement in hemoglobin or albumin levels.<sup>21-23</sup> Half-and-half nails have been reported with Kawasaki disease, hepatic cirrhosis, Crohn disease, zinc deficiency, chemotherapy, Behçet disease, and pellagra.<sup>3,24,25</sup> They should be distinguished from Terry nails, which are characterized by leukonychia involving more than 80% of the total nail length.<sup>26</sup>

**Black-brown vertical lines may represent nail trauma, infection, endocrine disorders, melanoma, or benign nevi**

**TABLE 1**

**Vertical brown-black nail lines (longitudinal melanonychia): Indications for referral**

- Any new vertical brown-black nail lines in a fair-skinned patient
- Vertical brown-black lines on a single nail, in any patient
- Any history of change in the brown-black lines or bands (darkening, widening, bleeding)
- Width of brown-black lines greater than 6 mm
- Proximal width greater than distal width
- Heterogeneous color
- Indistinct borders
- Associated nail fold pigment (Hutchinson sign)
- Associated nail plate dystrophy
- Associated bleeding
- Associated ulceration
- High-risk digit (thumb, index finger, great toe)
- Personal or family history of melanoma

**TABLE 2**

**Red nail lines (longitudinal erythronychia): Indications for referral**

Localized form (one nail affected)	Polydactylous form (multiple nails affected)
Pain, tenderness, sensitivity to cold (probable glomus tumor)	No associated systemic disease
Changing, evolving, or new band	No associated dermatologic disease

**Terry nails** were originally reported in association with hepatic cirrhosis, usually secondary to alcoholism<sup>27</sup> but have since been found with heart failure, type 2 diabetes mellitus, pulmonary tuberculosis, reactive arthritis, older age, Hansen disease, and peripheral vascular disease.<sup>3,26,28,29</sup>

**LONGITUDINAL MELANONYCHIA: VERTICAL BROWN-BLACK NAIL LINES**

Longitudinal melanonychia is the presence of black-brown vertical lines in the nail plate. They have a variety of causes, including blood from trauma; bacterial, fungal, or HIV infec-

tion; drug therapy (eg, from minocycline); endocrine disorders (Addison disease); exogenous pigmentation; or excess melanin production within the nail matrix.<sup>30-32</sup> They may also be a sign of a benign condition such as benign melanocytic activation, lentigines, or nevi, or a malignant condition such as melanoma (Figure 3).<sup>33,34</sup>

**When to suspect melanoma and refer**

Although melanoma is less commonly associated with brown-black vertical nail lines, awareness of melanoma-associated longitudinal melanonychia reduces the likelihood of delayed diagnosis and improves patient outcomes.<sup>35</sup> Also, it is important to remember that although nail melanoma is more common in the 5th and 6th decades of life, it can occur at any age, even in children.<sup>36</sup>

Findings that raise suspicion of nail melanoma (Table 1)<sup>33,37</sup> and that should prompt referral to a dermatologist who specializes in nails include the following:

- A personal or family history of melanoma
- Involvement of a “high-risk” digit (thumb, index finger, great toe),<sup>30,31,38</sup> although nail melanoma can occur in any digit
- Any new vertical brown-black nail pigmentation in a fair-skinned patient
- Only one nail affected: involvement of more than one nail is common in people with darker skin, and nearly all patients with darker skin exhibit longitudinal melanonychia by age 50<sup>31</sup>
- Changes in the band such as darkening, widening, and bleeding
- A bandwidth greater than 6 mm<sup>33</sup>
- A band that is wider proximally than distally<sup>34</sup>
- Nonuniform color of the line
- Indistinct lateral borders
- Associated with pigmentation of the nail fold (the Hutchinson sign, representing subungual melanoma),<sup>31,39</sup> nail plate dystrophy, bleeding, or ulceration.<sup>33</sup>

While these features may help distinguish benign from malignant causes of longitudinal melanonychia, the clinical examination alone may not provide a definitive diagnosis. Delayed diagnosis of nail melanoma carries a high mortality rate; the internist can promote early diagnosis by recognizing the risk factors

and clinical signs and referring the patient to a dermatologist for further evaluation with nail biopsy.

### LONGITUDINAL ERYTHRONYCHIA: VERTICAL RED NAIL LINES

Longitudinal erythronychia—the presence of one or more linear red bands in the nail unit—can be localized (involving only one nail) or polydactylous (involving more than one nail). The localized form is usually due to a neoplastic process, whereas involvement of more than one nail may indicate an underlying regional or systemic disease.<sup>13</sup> **Table 2** lists indications for referral to a nail specialist.

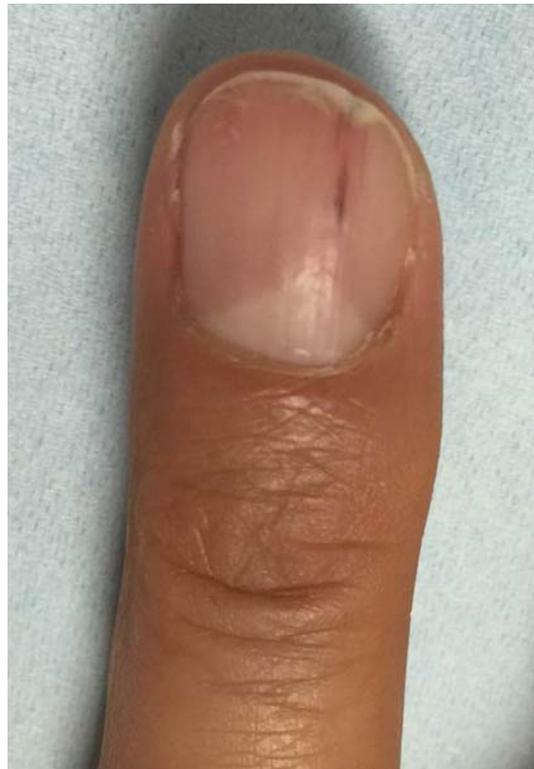
#### General features on examination

Clinical examination reveals one or more linear, pink-red streaks extending from the proximal nail fold to the distal free edge of the nail plate (**Figure 4**). The width of the band typically ranges from less than 1 mm to 3 mm.<sup>40</sup> Other features may include splinter hemorrhages within a red band, a semitransparent distal matrix, distal V-shaped chipping, splitting, onycholysis of the nail plate, and reactive distal nail bed and hyponychial hyperkeratosis. These features can be visible to the naked eye but may be better viewed with a magnifying glass, a 7× loupe, or a dermatoscope.<sup>13</sup>

Localized longitudinal erythronychia is usually seen in middle-aged individuals and is most commonly found on the thumbnail, followed by the index finger.<sup>41,42</sup> The condition may be asymptomatic, but the patient may present with pain or with concern that the split end of the nail catches on fabrics or small objects.<sup>42</sup>

#### Glomus tumor

Intense, pulsatile pain with sensitivity to cold and tenderness to palpation is highly suggestive of glomus tumor,<sup>43</sup> a benign neoplasm that originates from a neuromyoarterial glomus body. Glomus bodies are located throughout the body but are more highly concentrated in the fingertips, especially beneath the nails, and they regulate skin circulation. Therefore, the nail unit is the most common site for glomus tumor.<sup>44,45</sup> A characteristic feature of subungual glomus tumor is demonstration of tenderness after pin-point palpation of the



**FIGURE 4.** Longitudinal erythronychia presents as one or more linear red bands extending from the lunula to the distal free edge of the nail plate, accompanied by onycholysis.

suspected tumor (positive Love sign).<sup>45</sup> While it is typical for glomus tumor to affect only one nail, multiple tumors are associated with neurofibromatosis type 1.<sup>46</sup> Confirmation of this diagnosis requires referral to a dermatologist.

#### Other causes of localized red nail lines

Onychopapilloma, a benign idiopathic tumor, is the most common cause of localized longitudinal erythronychia. Unlike glomus tumor, it is usually asymptomatic.<sup>42,47</sup> Less common benign conditions are warts, warty dyskeratoma, benign vascular proliferation, a solitary lesion of lichen planus, hemiplegia, and postsurgical scarring of the nail matrix. In some cases, the lines are idiopathic.<sup>42,43</sup>

Malignant diseases that can present as localized longitudinal erythronychia include invasive squamous cell carcinoma, squamous cell carcinoma in situ (Bowen disease), and, less frequently, amelanotic melanoma in situ, malignant melanoma, and basal cell carcinoma.

**Red nail lines on a single nail may represent squamous cell carcinoma**



**FIGURE 5.** Beau lines—transverse grooves in the nail plate—have been associated with rheumatic fever, malaria, pemphigus, Raynaud disease, and myocardial infarction.

noma.<sup>42</sup> Squamous cell carcinoma in situ most commonly presents in the 5th decade of life and is the malignancy most commonly associated with localized longitudinal erythronychia. Clinically, there is also often nail dystrophy, such as distal subungual keratosis or onycholysis.<sup>43</sup>

Patients with asymptomatic, stable localized longitudinal erythronychia may be followed closely with photography and measurements. However, any new lesion or a change in an existing lesion should prompt referral to a dermatologist for biopsy.<sup>13</sup>

**Red streaks on more than one nail**

Polydactylous longitudinal erythronychia usually presents in adults as red streaks on multiple nails and, depending on the presence or absence of symptoms (eg, pain, splitting), may be the patient’s chief complaint or an incidental finding noted by the astute clinician. Often, it is associated with systemic disease, most commonly lichen planus or Darier disease.

Lichen planus is a papulosquamous skin disease with nail involvement in 10% of pa-

tients and permanent nail dystrophy in 4%. Common nail findings include thinning, longitudinal ridging, and fissuring, as well as scarring of the nail matrix resulting in pterygium. Linear red streaks may accompany these more typical nail findings.<sup>13</sup> Patients with Darier disease present with alternating red and white linear bands on multiple nails as in leukonychia striata.

Less frequently, polydactylous longitudinal erythronychia is associated with primary and systemic amyloidosis, hemiplegia, graft-vs-host disease, acantholytic epidermolysis bullosa, acantholytic dyskeratotic epidermal nevus, acrokeratosis verruciformis of Hopf, or pseudobulbar syndrome, or is idiopathic.<sup>13,42,48</sup> Therefore, the physician evaluating a patient with these nail findings should focus on a workup for regional or systemic disease or refer the patient to a dermatologist who specializes in nails.

**■ BEAU LINES**

Beau lines are a common finding in clinical practice. They are not true lines, but transverse grooves in the nail plate that arise from the temporary suppression of nail growth within the nail matrix that can occur during periods of acute or chronic stress or systemic illness (Figure 5).<sup>49</sup>

The precipitating event may be local trauma or paronychia, chemotherapeutic agents cytotoxic to the nail matrix, or the abrupt onset of systemic disease.<sup>18,50</sup> The grooves have also been associated with rheumatic fever, malaria, pemphigus, Raynaud disease, and myocardial infarction, as well as following deep-sea dives.<sup>51-53</sup> The distance of a Beau line from the proximal nail fold can provide an estimate of the time of the acute stress, based on an average growth rate of 3 mm per month for fingernails and 1 mm per month for toenails.<sup>49</sup> ■

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