

REVIEW

Discoloured nails

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Abstract

The nails, in combination with skin, glands and hair, comprise the integumentary system. Abnormalities in the colour, shape and clinical appearance of nails can be indicative of pathophysiological disorders, habit-tics such as bitten nails, poor grooming, nutritional deficits and cosmetic practices. Discolouration and changes in nail appearance are common reasons for referral of individuals to dermatologists. This paper presents a mélange of common nail disorders with a clinical focus on those that present with discolouration.

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Introduction

The nails, in combination with skin, glands and hair, comprise the integumentary system. Nails are located on the distal dorsal phalanges of the fingers and metatarsals of the toes; their prime function is to protect the digits and, in the case of fingernails, act as useful 'tools' for precise picking, scratching and grasping dexterity. Fingernails begin to form at 10 weeks and toenails at 12 weeks' gestation, and they are derived from a hardened, transparent stratum corneum of the epidermis. The anatomical nail structure is classified as the nail root, body and free edge¹.

Nails are composed of hardened keratin which is generated in the germinal matrix (nail root) which lies under the proximal nail fold. At the distal edge of the matrix is the visible lunula or white 'moon'. The matrix and lunula are responsible for growth of the nail. The lunula appears white as the epidermis below is thicker in the matrix and this inhibits the pink refraction from blood vessels in the nail bed below. Furthermore, the viable cells within the lunula are still undergoing keratinisation. Nails appear pink in Caucasians and tinted bluish in dark skinned individuals. As nail cells move from the matrix over the vascular nail bed they form the nail plate or hard keratin structure which is divided into the nail body and free edge².

The nail body (*corpus unguis*) is the attached, translucent portion of nail that extends from the lunula to the free edge. The free edge extends from the nail body beyond the finger tip and is attached to the nail bed by the hyponychium. The

length of the free edge is related to cosmetic preference and local wear forces applied during activities of daily living. The eponychium (cuticle) covers the matrix and protects against invasion of organisms. The proximal nail fold is the thickened skin at the base of the nails and the lateral nail fold is a similar fold of skin at the lateral edges³.

Fingernails grow at approximately 1.5mm per week in children under the ages 10–14⁴ and 1mm per week in adults¹, but the growth of toenails is slower. Any abnormality in colour and appearance of nails can be indicative of pathophysiological disorders, habitual behaviours such as picking or biting nails, poor grooming, nutritional deficits or use of nail cosmetics. This paper focuses on conditions associated with discoloured nails.

Diagnostic investigations

There are many reasons for discoloured nails; those outlined in this paper will be discussed under infection, trauma, pathological conditions and atypical aetiologies. Diagnostic investigations for confirmation of nail infection involves microscopy and culture of skin swabs, sub-nail tissue scrapings and nail clippings. In addition, mycology for diagnosis of moulds and fungi may be required. Biopsy and histopathological investigations of the nail plate requires specialised skill and frequently leads to significant discomfort and potential for scarring. Therefore, a clinical diagnosis is more pragmatic and is based on the individual's relevant clinical history and examination of the nails and the surrounding skin.

Infections

Fungal infections

Onychomycosis is a fungal infection of the nail caused by dermatophyte or non-dermatophyte organisms that can result in discolouration and separation of the nail from the nail bed⁵. Between 18–40% of all nail disorders that result in discolouration are due to onychomycosis of the nail^{6,7}. Nail infections contribute to 30% of all dermatomycoses which are fungal infections of the hair, nail and skin^{6,7}. Nail plate invasion by fungal organisms usually follows penetration of hyphae (fungal filaments) along the distal and lateral border on the under-surface of the nail plate, which is the main route of nail invasion by dermatophytes. Penetration may also originate from the proximal nail fold (Figure 1).

Tinea unguium is most commonly caused by *Trichophyton rubrum*; less frequently *Trichophyton interdigitale* or *Epidermophyton floccosum* are found to be problematic. *T. rubrum* is only found on humans and is particularly prevalent in damp environments and in the presence of recurrent nail trauma⁵.

Onychomycosis is diagnosed with microscopy and culture of nail clippings and the crumbly material under the nail. Nail specimen collection is a skilled art and collection of appropriate specimens is dependant on the skill of pathology collection staff. Not infrequently patients report they are requested to take their own samples, which increases the risk of inaccurate diagnoses. The treatment gold standard for onychomycosis is oral antifungal therapy such as 3 months of terbinafine 250mg daily. Itraconazole 50mg or 100mg may be effective as a pulse therapy for 1 week every month^{8,9}. This cycle is repeated three times for toenails and twice for fingernails and patients need to be advised that the antifungal agents will be imbedded in the nail. By the end of the treatment course there should be evidence of new nail regrowth, although it will take over 6–9 months to replace the damaged nails. It is always worthwhile advising patients that re-infection is likely. The cure rate falls dramatically in those over 60 years old or when associated with comorbidities such as diabetes and vascular disease⁵⁻⁷.

Mould infections

The most common mould is *Candida*. There are two main



Figure 1. Onycholysis and destroyed distal nail plate as a result of chronic dermatomycosis. Dermatophyte identified on culture as *T. rubrum*

forms of nail infection; one is acute paronychia and the other is onychomycosis. *Candida paronychia* is found in wet, damp environments, for example those experienced by underground miners with hot, wet, sweaty feet. Fingernail involvement is most frequently found in those who have their hands occupationally wet, e.g. nurses, cooks, hairdressers, barmaids. Occasionally cultures will show both a dermatophyte and a mould infection. Itraconazole, as previously discussed, is the treatment of choice, although it is not on the PBS⁸. However, mould infections found in those with comorbidities, such as diabetes, or the very elderly, are far less likely to respond to oral therapy. Furthermore, both fungal and mould infections do not always respond to topical treatments or laser therapy⁵⁻⁸.

Bacterial infections

A characteristic green discolouration of the nails is seen with heavy colonisation of *Pseudomonas aeruginosa*. This follows either primary or secondary onycholysis, with the nail colour presenting as dark to light shade of green (Figure 2). Onycholysis can be superimposed with a *Pseudomonas* infection^{5,9}. Again, excessive immersion of nails in water or exposure to dampness seems to be a significant inducing co-factor for infected toenails⁹. With regard to treatment, compounded thymol 4% in chloroform is effective. The use of supermarket vinegar may be considered and applied as a douche using a disposable syringe. This treatment option is readily available, cheap and extremely simple.

Paronychia

Paronychia is defined as infection or inflammation of the proximal or lateral nail folds, and may be classified as acute or chronic¹⁰. Acute paronychia is usually caused by invasion of pathogens such as *Staphylococcus aureus*¹¹, whereas chronic paronychia is found in patients who have repeatedly traumatised their hands and nails due to frequent and extended immersion of hands in water (Figure 3)^{10,11}. Chronic paronychia may be due to bacterial infection such as *S. aureus* or *P. aeruginosa* (which may lead to a blue/green discolouration of the nail) or chronic mycotic or yeast infection^{11,12}. If attempts to keep the skin clean and dry are not effective then topical treatment with the compounded vinegar and thymol 4% may prove effective for mycotic or yeast infection.



Figure 2. Onycholysis with secondary *Pseudomonas* infection. Dry dermatitis on the medial aspect of the thumb, ridging along the thumbnail itself, and loss of proximal nail fold

Trauma

Haematoma

Nail pigmentation due to haematoma may also be described as talon noir, a benign trauma-induced darkening or calcified haematoma or petechiae, and is the commonest injury inflicted on the nail^{13,14}. Frequently the bleeding under the nail plate is not immediately apparent and causes the patient significant anxiety and concern when it presents at a later date. It is sometimes possible to show the patient that the blood is attached to the nail plate and not to the nail bed. This makes for a definitive diagnosis of a melanocytic lesion as compared to haematoma. Alternatively, a punch biopsy of the nail plate can differentiate these lesions. A small section of the nail plate is collected and if pigmentation caused by coagulated blood is found to be attached to the nail plate with a clear visible nail bed underlying, this is indicative of haematoma^{14,15}.

Habit-tic dystrophy

Habit-tic dystrophy is caused by habitual external trauma such as scratching or picking. It is frequently related to obsessive-compulsive behaviours¹⁶. The damage is usually inflicted on the thumb nail by one of the fingers of the same hand, which leads to characteristic depressions and transverse or parallel ridging across the nail (Figure 4). In severe cases, the cuticles may be eroded and the lunula can hypertrophy. Interestingly, most individuals don't realise they are doing it and getting patients to acknowledge and overcoming their habit is challenging¹⁶.



Figure 3. Chronic paronychia with hyperpigmentation of the lateral nail and loss of proximal nail fold due to excessive water contact



Figure 4. Characteristic nail dystrophy caused by habitual picking and scratching along the nail

Pathophysiological conditions

Malignant melanoma

A melanoma is a malignant lesion arising from melanocytes, the cutaneous pigment producing cells¹⁷. Although extremely rare, malignant melanoma of the nail plate is a subtype of cutaneous melanoma, and originates in the nail matrix melanocytes¹⁸. It is not reported to be related to sun exposure and can present as partial to total nail pigmentation and periungual pigmentation^{17,18}. However, 25% of melanomas in these areas are amelanotic and can present as pyogenic granuloma, granulation tissue, ingrown nail and micro-bacterial infection with nail dystrophy¹⁸. Subungual melanoma is more common in African-American, Asian and Hispanic populations, males in their 70s and females in their 60s, and is more predominate on the thumb, hallux and index finger^{19,20}. An ABCDEF mnemonic devised by Levit et al.²¹ assists in diagnosing subungual melanoma and outlines:

- A: Age (50–70 years old); African, Japanese, Chinese and Native American ethnicity.
- B: Brown-black pigmented band ≥ 3 mm with blurred borders.
- C: Change despite treatment.
- D: Digits most commonly involved are thumb, index finger or hallux.
- E: Extension of pigment into the skin surrounding the nail (Hutchinson sign).
- F: Family or personal history of melanoma or atypical nevus.

Unfortunately, melanoma of the nail often goes undiagnosed or is misdiagnosed; this may explain why the Jamaican reggae musician Bob Marley succumbed to a toenail plate melanoma²². However, an early diagnosis and treatment can significantly improve the prognosis²⁰.

Psoriasis

Psoriasis is a very common cutaneous disease; it can affect the nails and may clinically indicate underlying joint inflammation, that is, psoriatic arthritis¹¹. Few patients are asymptomatic and the range of presentations is extremely varied (Figures 6 and 7). Some individuals may have no



Figure 5. Pitting of the nail as found in psoriasis. The keratinocytes that are being laid down into the proximal nail plate under the nail fold do not adhere and elements of the nail fall apart; this is highly suggestive of underlying joint disease

observable psoriasis on full skin examination other than a little bit of scale and flake behind the ears or a touch of hyperkeratosis on the elbows and knees. Those with a history of skin psoriasis or examination findings of psoriasis on the skin make for easier diagnosis of nail disease, although nail clippings and histopathological examination can provide a definitive diagnosis. Psoriasis can affect nails in many different ways, predominantly with pitting, thickening, crumbling, leukonychia (white discolouration), red spots in the lunula and onycholysis¹¹. Pitting suggests nail matrix disease. Onycholysis can occur due to nail bed disease and the use of potent topical steroid or vitamin D analogues as a fluid/gel manually rubbed into the affected area may be the treatment of choice. However, when faced with multiple affected nails or significant destruction, then systemic therapy is the treatment of choice^{11,13,15}.

Atopic dermatitis

Atopic dermatitis is a common skin disorder characterised by chronic inflammation, sensitive dry skin, localised or disseminated eczematous lesions, itching and epidermal-barrier dysfunction²³. Chronic or acute dermatitis can affect the nails in many different ways (Figure 7). Most commonly there is destruction of the proximal nail fold. However, atopic dermatitis may cause nail pitting, trachyonychia (rough, longitudinally ridged nails), Beau's lines (transverse grooves), onychomadesis (separation of the nail plate from the nail matrix) and onychoschizia (brittle, split, soft or thin nails)²⁴. A definitive diagnosis is made on examination of the hands for signs of weeping, vesicular or lichenified skin and signs of scratching. Nail changes resolve once the dermatitis is controlled with perhaps the exception of nail fold covers^{14,15}.

Myxoid cysts

Myxoid cysts are benign pseudocysts and are also known as synovial cysts, periungual ganglia and joint tendon sheath cysts²⁵. They present as soft or firm nodules on the distal intraphalangeal joint or proximal nail fold of the fingers in middle aged or elderly individuals, particularly women. They usually measure <10mm and contain transparent or yellow coloured jelly-like fluid which is comprised of hyaluronic acid, globulin, glucosamine and albumin^{25,26}. These cysts are considered to be due to osteoarthritis arising in the underlying joint cavity.



Figure 6. Severe psoriasis; it is always worthwhile doing skin scrapings and clippings to eliminate superimposed *Candida* or other moulds

If the cyst causes pressure on the nail bed it can affect nail growth with subsequent dystrophy²⁶ (Figure 8). Treatments involve needling of the cyst and, although some recommend cryosurgery as a therapy, it is not particularly effective, nor are intralesional steroid injections^{25,26}. A referral to a hand surgeon may be warranted if the patient is distressed by the cosmetic appearance.

Atypical aetiologies

Longitudinal melanonychia

These lesions are a tan, brown or black longitudinal streaks within the nail plate¹¹. They are caused by increased melanin deposition in the nail itself which arises from either greater melanin synthesis by normally non-functional matrix melanocytes or from an increase in the total number of matrix melanocytes that synthesise melanin²⁷. The lesions originate most often because melanocytes have become more active rather than increased density of pigment cells^{27,28}. Individuals presenting with longitudinal melanonychia are relatively common and those from Africa, Central and East Asia by far



Figure 7. Nail dystrophy caused by chronic atopic dermatitis. There is some chronic paronychia with boggy periungual swelling on the index finger. There is pterygium formation on the second finger, namely the long ridge with a distal split; this is where there has been fracture to the nail plate. A break to the actual nail bed is usually post-trauma. Such findings can also occur in lichen planus which is characteristic of atopic dermatitis



Figure 8. Myxoid cyst denting the nail due to pressure on the proximal nail fold; visible soft tissue swelling in the tissue just proximal to the nail plate

outnumber Caucasians with this presentation. The lesions are found more commonly in dark skinned individuals; 77% of African-Americans over the age of 20 years have one finger affected and generally 100% in those over 50 years of age, and 10–20% of Japanese people are affected²⁹.

The gold standard diagnostic investigation for longitudinal melanonychia is a nail biopsy, which can be difficult and one not without risk of morbidity. Patients are frequently left with permanent nail bed damage and persistently dystrophic nails; postoperative bacterial wound infection is not infrequent. The pathology report can be entirely normal as we are frequently looking at increased activity of melanocytes and not an increased number²⁸. In practice, when patients present with an already established nail pigmented streak that has been present for some years and unchanged in appearance, it is likely to be benign rather than malignant. However, it is always worthwhile to emphasise that lesions can change and any substantial change in the index lesion requires review. When a lesion has been present for a few weeks or months and there is a suggestion that it is still evolving, it is advisable to photographically record the nail image and review the patient in 3 months. Surgical biopsy is offered and the ensuing discussion regarding the pros and cons of observation verses biopsy should be recorded in the patient's records.

Conclusion

Nail abnormalities have more than cosmetic impacts. The appearance of nails can be indicative of pathophysiological disorders, habit-tics, poor grooming, nutritional deficits and cosmetic practices. Discolouration of nails in particular is frequently related to infection, trauma, pathological disorders or habit-tics. Awareness of common nail abnormalities such as discolouration and the potential aetiologies can lead to early diagnosis and targeted treatment.

Conflict of interest

The authors declare no conflicts of interest.

Ethics statement

No ethical approval was required.

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