Chapter 4
White Superficial Onychomycosis

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Key Features
- In SWO the route of infection occurs via the dorsal aspect of the nail plate.
- There are two variants of SWO: a superficial and a deep variant. SWO can rarely be pigmented. Rarely, SWO originates from beneath the proximal nail fold.
- Deeper nail penetration has been linked to mold infection.
- SWO is commonly associated with DLSO.
- SWO can be treated with topical antifungals in most cases.

Introduction

Superficial white onychomycosis (SWO) refers to a form of onychomycosis that involves invasion of the nail plate through the dorsal surface (Fig. 4.1), presenting as opaque, friable, whitish superficial spots (Fig. 4.2) [1, 2]. However, this name is somewhat of a misnomer, as recent evidence supports a new classification of variants that includes a deep form of nail penetration. Organisms responsible for causing SWO include *Trichophyton mentagrophytes* var. *interdigitale*, which involves

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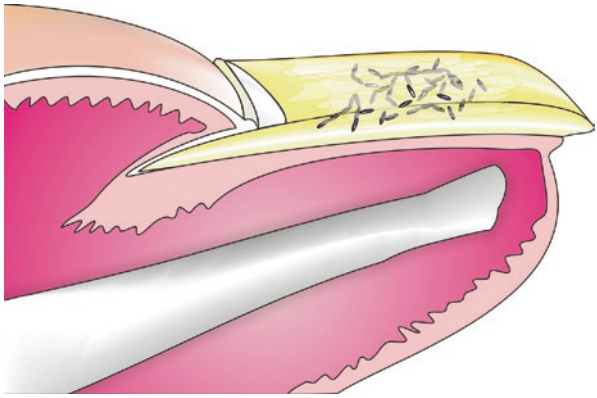

Fig. 4.1 SWO schematic drawing showing fungal invasion of the dorsal nail plate

Fig. 4.2 SWO dermoscopy shows that the superficial nail plate is affected

90 % of cases, *Trichophyton rubrum*, or non-dermatophytes (molds), such as *Acremonium*, *Fusarium*, or *Aspergillus* species [1, 3, 4]. Infections from *Trichophyton rubrum* var. nigra or *Neoscytalidium dimidiatum* may cause "superficial black onychomycosis," when dark pigmentation is observed [5–7]. Of note, mixed

dermatophyte/non-dermatophyte infections may occur as well [8]. SWO usually affects the first, second, or third toenails. Fingernail involvement has rarely been reported in newborns or in HIV patients [7]. Toenails grow 50–66 % more slowly than fingernails, which can facilitate fungal infection [9]. Associated conditions include interdigital tinea pedis and, less frequently, plantar tinea pedis, both of which result from infection with *Trichophyton interdigitale* [7].

Epidemiology

Onychomycosis generally affects men more commonly than it affects women. Associated factors include diminished peripheral circulation, diabetes, trauma to the nail, and inadequate nail hygiene [10]. SWO is a rare type of onychomycosis that constitutes 1.5–7 % of all reported cases of fungal nail infections [11]. While SWO affects about 1–2 % of the general population, the incidence increases with age. Rate of prevalence is higher in the immunosuppressed, with 9.5 % of HIV-infected patients reportedly affected by SWO [7]. However, epidemiological characteristics may also vary according to the variant of SWO involved.

Clinical Features

There are two main subtypes of SWO: classical SWO and deep SWO (Figs. 4.3 and 4.4). In classical SWO, the superficial nail plate presents small white opaque friable patches with distinct borders. Scraping of the patches allows removal of the whitish surface material, exposing a transparent compact median nail plate. Sometimes, the patches may coalesce with time to involve the entire nail that becomes diffusely milky, white, and opaque [1, 3, 7]. One variant of classical SWO involves a route of infection that arises from below the proximal nail fold. This form of SWO, which may be difficult to distinguish from proximal subungual onychomycosis (PSO), most commonly affects children, who have thin nails, or immunosuppressed patients [1, 3]. In some cases, this variant presents with striate superficial bands, with affected white bands alternating with unaffected nail (Fig. 4.5). Deep invasion of the nail plate usually results from infection with non-dermatophytic molds, such as *Fusarium* and *Aspergillus* species, due to their eroding bodies which enable penetration of the nail plate barrier (Fig. 4.6) [4]. This deep variant is characterized by diffuse white and yellow-brown patches (Figs. 4.7 and 4.8). Nail plate discoloration may extend to the proximal nail fold, and the pigmentation can be visible through the cuticle [7]. Combination of SWO with another type of onychomycosis, such as distal and lateral subungual onychomycosis (DLSO) or proximal subungual onychomycosis (PSO), is not uncommon (Figs. 4.9 and 4.10) [1, 2].

Fig. 4.3 SWO classical type

Fig. 4.4 Deep SWO

Fig. 4.5 SWO with striated pattern

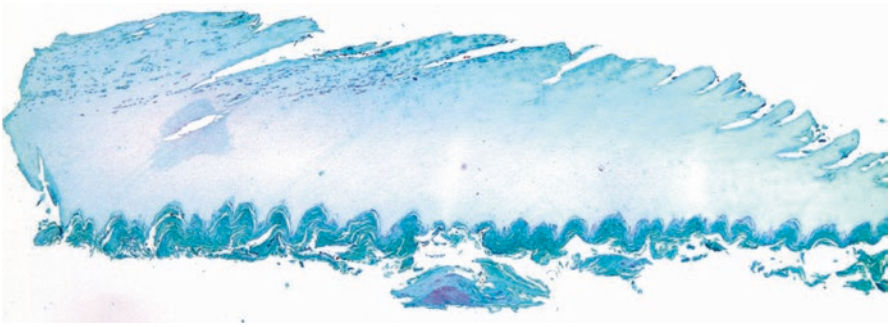

Fig. 4.6 Deep SWO: pathology shows fungal elements in the superficial and mid-nail plate

Diagnostic Clues

It is important to conduct mycological studies, in order to appropriately diagnose and treat onychomycosis [10]. Diagnosing SWO may be performed using direct microscopy with 40 % potassium hydroxide (KOH) mounts, fungal cultures, and nail clippings with periodic acid-Schiff (PAS) staining for histologic analysis (Fig. 4.11) [7, 12]. In some cases of SWO, taking a clipping might be difficult, as the infection is often located in the central part of the nail plate without involvement of the distal nail. Scraping of the superficial nail plate is the best way to obtain samples for KOH and culture. Of note, potassium hydroxide microscopy and culture carry a relatively low negative predictive value (<60 %) and, therefore, warrant repeat testing in patients with possible SWO that initially test negative [12].

When attempting to clinically distinguish the type of SWO involved, one can suspect a deeper invasion of the nail plate when scraping the dorsal surface fails to completely remove the white discoloration [3].

Fig. 4.7 SWO yellowish desquamating patch

Fig. 4.8 SWO: note the yellow-white discoloration and crumbling of the nail surface

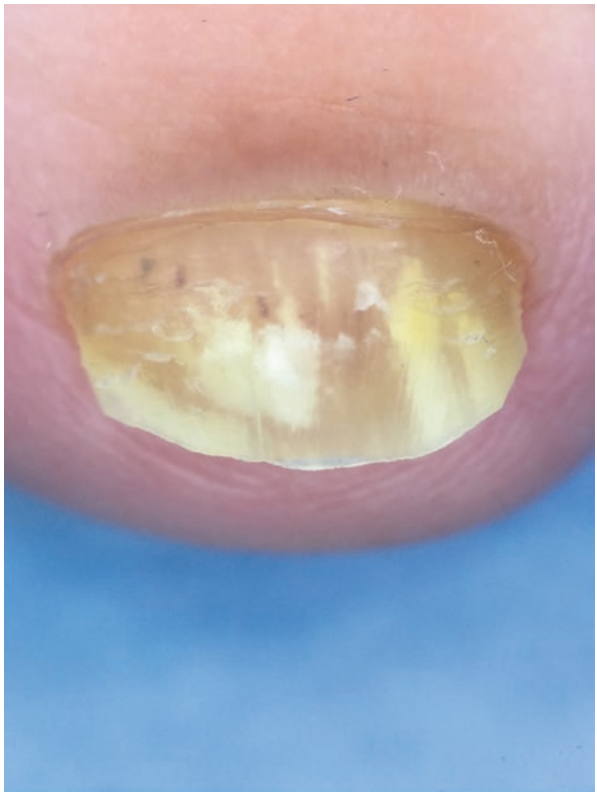

Fig. 4.9 SWO and DLSO affecting the same nail

Fig. 4.10 SWO emerging from proximal nail fold and DLSO

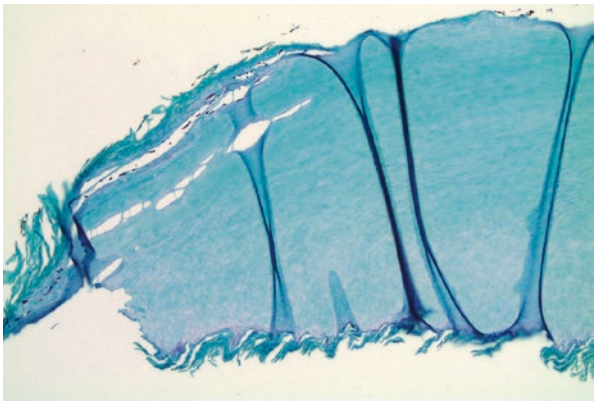

Fig. 4.11 SWO pathology shows fungal elements in the superficial nail plate

Summary for the Clinician

Clinicians must take into account features of both the host and causative organism in the treatment of patients with SWO. Dermatophytes contain keratolytic enzymes that allow them to break down the hard keratins of the nail plate. In vitro studies have shown the high osmotolerance characteristic of *T. interdigitale*, which contributes to its ability to invade the dry nail plate. However, it is important to note that SWO in HIV patients is commonly due to *T. rubrum* and may involve the fingernails. In the rare circumstances when *T. rubrum* is observed in immunocompetent individuals, it is usually the result of nail plate occlusion from an overriding toe. Other host factors involved in promoting SWO infections include diminished immune function, genetics, and nail plate thickness. For example, fungal invasion is more likely to involve the entire thickness of the nail plate in children who have thinner nails than adults. However, host factors are not likely implicated in SWO due to *Aspergillus* or *Fusarium*, as both species carry intrinsic properties that allow them to penetrate the nail's dorsal surface with greater depth and the affected hosts are typically healthy [7].

First-line treatment depends on the variant of SWO and generally entails mechanical removal, followed by administration of topical antifungals, with systemic antifungal agents, such as terbinafine or itraconazole, reserved for patients resistant to topical agents for more than 6 months [7, 11]. However, topical therapy is usually ineffective when the infection originates from beneath the proximal nail fold. It should be reserved for the classical variant of SWO, in which infection remains at a superficial level [5]. Systemic antifungal agents may be used either alone or in combination with topical antifungal, when the infection originates from below the proximal nail fold, when there is deep invasion or when there is a combination of variants present [1, 5].

Those infections emerging from below the proximal nail fold can share a similar fungal etiology as PSO, and therefore warrant close inspection. When clinicians isolate *T. rubrum* or *Fusarium* species from SWO patients, they should analyze the affected nail for any signs of mixed variants or for infection emerging from beneath the proximal nail fold [1]. Gupta et al. highly recommended partitioned sampling in the presence of mixed variants, such as SWO and DLSO, and using it together with other diagnostic methods when appropriate. For infections involving both dermatophyte and non-dermatophyte molds, it is important to prioritize treatment of the dermatophyte and then subsequently treat any residual non-dermatophyte infection [8].

Treatment differs slightly for children due to their thin nail plates. Topical treatments are effective even when children have diffuse nail plate involvement, as their thin nails can facilitate drug penetration [7]. Although pediatric use of topical antifungals is not approved, topical amorolfine once a week has been reported as a successful treatment of SWO, due to *T. rubrum*, in an HIV-infected child. Adverse effects are unlikely, as this drug is not absorbed systemically [13].

Clinical Pearls for Reader

- Think of SWO in case of pseudo-leukonychia of the toenails.
- Keratin degranulation from continuous use of nail polish may mimic SWO.
- Think of molds in case of diffuse and deep involvement.
- Scrape the nail to distinguish between SWO originating from the proximal nail fold and PSO.
- Scraping of the affected nail and topical antifungal treat SWO in most cases.

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