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# Onychomycosis to Fungal Superinfection: Prevention Strategies and Considerations

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## ABSTRACT

Onychomycosis is the most common fungal skin infection, and it is frequently seen in the setting of other concomitant fungal infections, the most common being tinea pedis. Infected nails become a reservoir of fungal organisms that may infect the skin, and vice versa. Early, effective treatment of the nails is necessary for preventing not only permanent structural damage but also the spread and superinfection of the surrounding skin and soft tissue. Moreover, treatment of the skin is important for preventing re-infection of the nails.

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## INTRODUCTION

Onychomycosis is estimated to affect 12% of the United States population and represents 50% of all nail disorders.[1,2] The incidence of skin dermatophyte infections is thought to be between 10% and 20% of the U.S. population. This translates to upwards of 59 million Americans experiencing at least one cutaneous fungal infection in any given year.[3] While male gender and increasing age have been identified as predisposing factors, an equal proportion of men and women seek care for fungal infections. Moreover, according to Intercontinental Marketing Services (IMS) data, 63% of patients who filled prescriptions for oral terbinafine for onychomyosis were younger than 55 years.[4]

Onychomycosis is a fungal infection of the nail unit, which includes the nail plate itself along with the nail bed and periungual tissue. Clinically, the nail may become thick and discolored with separation from the nail bed. Onychomycosis is a progressive disease that, if left untreated, can lead to permanent nail damage and associated discomfort. In addition, local extension or spread to other body parts or to close contacts, as well as superinfections, may develop.[5,6,7] Finally, despite the best efforts in treatment, onychomycosis patients frequently relapse, with recurrence rates estimated to be between 40% and 70%.[8,9] For these reasons, early effective therapy is important.

It is estimated that one-third of patients with onychomycosis also have tinea pedis, most commonly the inter-digital subtype.[10] The infected nails serve as a fungal reservoir that infects the skin and causes the tinea pedis infection.[11,12] Because of this, it is important for onychomycosis patients to be evaluated for concurrent tinea pedis. Moreover, treating both conditions at the same time yields the best outcome in preventing a cyclical spread of fungus between the skin and the nails.[4] The presence of tinea pedis has been shown to more than double the risk for subsequently developing onychomycosis or a recurrence once it has been cured.[13]

### Predisposing Factors

Several demographic, underlying medical, lifestyle, and climatic factors influence patients' risk of developing both onychomycosis and tinea pedis. These infections have been shown to be more prevalent in men than in women, and in older compared with younger patients, as well as in smokers. Those with medical conditions such as poor peripheral circulation, diabetes, and immune deficiency are also at higher risk. Recent studies also suggest that there may be a genetic susceptibility to developing fungal infections. Finally, the incidence of dermatophyte infections has been linked to living in warmer, more humid environments as opposed to in areas that are arid and dry.[1,2,14]

Lifestyle and hygiene also come into play in predisposing patients to dermatophyte infections. Wearing occlusive shoes, along with heavy perspiration and poor foot hygiene, create a moist environment that encourages invasion of fungi into the skin and nails. Moreover, exposing the feet to fungi by walking barefoot in public facilities such as gyms and swimming pools where humidity is high and fungi are prevalent also increases risk. Finally, frequent visits to nail salons has also been identified as a risk factor, as infection may be spread from dirty instruments or infected foot-soaking basins.[1,2,14]

### Prevention Strategies

While many of these factors are unavoidable, extra attention should be paid to those that can be avoided. Patients with peripheral vascular disease, diabetes, or immunodeficiencies should regularly inspect their feet and visit their dermatologists

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**TABLE 1.**

| Risks of Not Treating Onychomycosis |
|---|
| Nail dystrophy, which can be permanent. |
| Pain. |
| Local extension of fungal infection, eg, other toe nails. |
| Distant spread of fungal infection, eg, tinea pedis, tinea corporis, tinea cruris. |
| Bacterial superinfection and cellulitis. |
| Development of systemic allergic or Id reaction. |

or podiatrists. Nails should be kept neatly trimmed. The cutting of cuticles should be avoided because the abrasions and lacerations serve as a portal of entry for fungal organisms. If toenails or feet are infected, hands and feet should be kept clean to prevent the infection from spreading.[9,15]

A non-hospitable environment should be created to prevent fungal growth. The feet should be kept cool and dry, with loose fitting shoes. Drying antifungal powders can be used in the socks on a regular basis, and socks that become wet from perspiration should be changed during the day. Water shoes or flip-flops should be worn in public gyms, locker rooms, and showers. Personal instruments should be brought to nail salons if no guarantees can be given regarding sterility.[9,15]

"This translates to upwards of 59 million Americans experiencing at least one cutaneous fungal infection in any given year."

## Why Treat Onychomycosis?

Onychomycosis is a progressive disease. If left untreated, affected nails will worsen and the infection is likely to spread to other nails. Severe onychomycosis is associated with nail dystrophy that may be permanent, even in some cases where patients achieve a mycologic cure.[6,7] Moreover, recent data suggest that early treatment of onychomycosis is more effective than treatment of long-standing disease. Not only is the target nail more easily cured, but the spread to other nails is also prevented.[16]

In addition to the local benefit of treating fungal nail infections, there is a more global health benefit as well. The spread of fungal organisms can infect not only other nails but also the skin of the feet. This includes the interdigital web spaces, the soles of the feet, or in severe cases the entire foot.[17,18] Besides the spread of fungal infections, compromised skin provides an entry portal for bacterial superinfections that may lead to cellulitis.[19,20] Superinfections are an especially significant health issue in diabetic patients, as neuropathy and lack of sensation may prevent early detection. Ultimately, diabetics are at a higher risk for foot ulcers, bacterial cellulites, and even osteomyelitis.[21,22] Finally, fungal infections of the nails and skin are rarely associated with allergic, Id, or autoeczematization reactions. Untreated fungal infections have been associated with asthma, atopic dermatitis, urticaria, and erythema nodosum.[19,20]

"Onychomycosis is a progressive disease that, if left untreated, can lead to permanent nail damage and associated discomfort."

Onychomycosis carries a significant burden and interferes with patients' quality of life. Half of patients may experience foot pain, and an estimated 30% of patients report that the disease interferes with their ability to wear normal shoes and socks.[19,23] Moreover, patients may experience difficulty walking and be embarrassed about the appearance of the nails. In some cases, especially as reported by females, patients may be so adversely affected that the nail infection interferes with their personal relationships and self-esteem.[24]

## Goals of Treatment

There are 2 primary goals in treating onychomycosis. Firstly, the therapy must eliminate the infection. Secondly, after the fungal infection has been cleared, patients must be left with a normal appearing nail.[25] The causative fungal organisms infect the nail itself, along with the skin beneath the nails. Effective therapy relies on both the ability of the drug to kill the fungus and the body's ability to restore a new, normal appearing nail. Once the nail is infected and dystrophic, it does not return to normal with treatment. Rather, a new, clean, uninfected nail is newly made in the nail matrix. As it grows out, it will replace the infected nail. This is a slow process, and even if the infection is

**TABLE 2.**

| Onychomycosis Predisposing Factors |
|---|
| **Gender:** Men > women. |
| **Age:** Older > younger. |
| **Cigarette Smoking.** |
| **Medical Conditions:** peripheral vascular disease, diabetes, immunodeficiency. |
| **Genetics.** |
| **Lifestyle:** wearing occlusive shoes, walking barefoot in public facilities. |
| **Frequent Pedicures at Nail Salons.** |

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**TABLE 3.**

| Onychomycosis Prevention Strategies |
|---|
| Regular inspection of the feet and nails. |
| Avoidance of cutting cuticles. |
| Changing socks and shoes during the day. |
| Prophylactic anti-fungal foot powders. |
| Use of water shoes or flip-flops in public facilities. |
| Use of personal instruments at the nail salon. |

cured, it can take up to a year for an abnormal nail to grow out. In the event that the nail matrix itself becomes damaged, then a new nail that is produced will appear abnormal, even if the previous fungal infection has been cleared.

"Failure to treat onychomycosis can put patients at risk for nail pain, permanent deformity, potential superinfection, and quality of life impairment."

## CONCLUSION

Onychomycosis is a common nail disease that carries a significant health burden. While many practitioners may overlook onychomycosis, it warrants treatment. Onychomycosis is commonly associated with concurrent tinea pedis, which should be evaluated for and treated along with the nails to prevent spread and reinfection. Failure to treat onychomycosis can put patients at risk for nail pain, permanent deformity, potential superinfection, and quality of life impairment.

## DISCLOSURES

Joshua A. Zeichner MD is an advisory board member, consultant, investigator, and speaker for Valeant Pharmaceuticals; and an advisory board member for Anacor, Exeltis, and PharmaDerm.

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