

How to...

Ten top tips on managing fungal infections of the diabetic foot



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Clinical manifestations of fungal infections are named according to the location of the site infected; for example, tinea barbae is a fungal infection of the beard, tinea cruris is a fungal infection of the groin (jock itch), and tinea favosa is a fungal infection of the scalp (crusty hair). Within the foot, we are faced with two common appearances: tinea pedis (athlete's foot); and tinea unguium (infection of the nails). The more recognised term for a nail infection is onychomycosis.

Tinea pedis and onychomycosis have a similar prevalence of about 15–20% of the population, and they often co-exist^[1,2]. Prevalence is usually higher in males and where people live in close proximity, such as a college campus or military camp.

Tinea pedis presents as pruritic, erythematous, inflamed regions on the feet that may be located between the toes (interdigital type [\[Figure 1\]](#)), on the sole (vesicular type), or on the medial and lateral aspects of the foot (moccasin type [\[Figure 2\]](#)). The most common fungi that cause tinea pedis are *Trichophyton rubrum* (80%) and *Trichophyton interdigitale* (15%)^[3]; others that may be seen less often include *Epidermophyton*

floccosum and *Microsporum*.

Commonly, but not always, tinea pedis presents alongside onychomycosis, resulting in dystrophic and discoloured toenails. Fungal infections are contagious, and without treatment can spread to both feet and every toenail; furthermore, they can spread between individuals.

As the fungi that cause athlete's foot require warmth and moisture to survive and grow, the primary method of incubation and transmission is when people who regularly wear shoes go barefoot in a moist communal environment, such as a changing room or shower, and then put on shoes. Transmission is host to host through infected squames; squames are flat, keratinised, dead cells shed from the outermost layer of a stratified squamous epithelium. The source is either directly from people with chronic infections or from long-lived arthrospores that reside in squames deposited in shoes, flooring, and carpets (fomites).

True nail infections with yeasts, such as *Candida albicans*, are rare and more likely to affect the finger nails^[4,5]. Rarely, they may also cause paronychia, which is inflammation and infection where the nail meets the skin^[4].



Figure 1. Interdigital tinea pedis.



Figure 2. Moccasin-type tinea pedis.

Fungal infections in the normal population can be uncomfortable and cosmetically unpleasant. However, they are unlikely to cause any serious complications. In people who are immunocompromised or at risk of foot complications, such as people with diabetes, there is an increased risk of developing secondary complications, such as bacterial infections, foot ulceration, paronychia, cellulitis, and an increasing risk of lower limb amputation^[6,7]. Therefore, the prevention, identification and management of fungal foot infections in these individuals is particularly important.

Ten top tips on managing fungal infections of the foot

1 Suspect fungal infection whenever the nail looks abnormal: Colour and dystrophy are the most important clues to diagnosis. Presentations include:

- Lateral onychomycosis, where white or yellow opaque streaks appear along one side of the nail.
- Distal onycholysis and hyperkeratosis, where scaling occurs under the distal nail; the nail is discoloured, opaque and thickened and, as a result, the end of the nail lifts up.
- Superficial white onychomycosis, where small, flaky, white patches and pits appear on the top of the nail plate; the nail becomes roughened and crumbles easily.
- Total dystrophic onychomycosis, where the nail is completely destroyed.

2 Presentation of tinea pedis. Tinea presents as pruritic, erythematous, and inflamed regions of the foot, commonly:

- Between the toes (interdigital).
- On the sole (vesicular type).
- On the medial and lateral aspects of the foot (moccasin type).

3 Guide to when a sample should be taken for a fungal infection^[3]:

- When oral therapy is being considered, usually for nail disease.
- In severe or extensive skin fungal infections, such as in moccasin-type athlete's foot (note that samples are NOT needed in uncomplicated athlete's foot).
- Where a secondary bacterial infection is suspected.
- Where there is diagnostic uncertainty.
- In at-risk groups, such as people with diabetes.

4 How to take a skin or nail sample^[3,5]. The following steps must be taken when taking a skin or nail sample:

- Wipe off any treatment creams, lotions, or powders with 70% alcohol before sampling.
- For skin samples, scrape skin using a scalpel from the advancing edge of the lesion; skin flakes >5 mm² are needed for microscopy.
- If superficial infection of the nail is suspected, use a scalpel to obtain scrapings of the surface of the nail.
- If deeper infection of the nail is suspected, use cuticle nippers to sample the diseased part of nail.
- When clipping the nail, include the full thickness of the nail and extend as far back from the nail tip as possible; viable fungi are most likely to be found in the most proximal part of the diseased nail. Include scrapings of debris from the area between the nail and nail bed. Denning et al^[4] found that culture for fungi was more likely to be positive the nearer the sample site was to the cuticle of the nail affected by onychomycosis.
- Keep the samples at room temperature – do not refrigerate them (dermatophytes die at low temperatures).
- False-negative rates are high (approximately 30%). Therefore, a negative test cannot definitively exclude fungal nail infection. Repeat the test if the result is negative and there is high clinical suspicion that the nail is infected.

5 Differential diagnosis for onychomycosis. Many nail problems can look like fungal infection, but only 45% of dermatology samples received are positive for fungal infection^[8]. The differential diagnosis for onychomycosis include^[9,10]:

- *Onychauxis*. Thickened nail, with or without ridges, often caused by trauma; trauma can be either major, such as a crush injury, or multiple, minor trauma, such as wearing protective toe caps.
- *Psoriasis*. Affected nails are pitted with shallow or deep holes. The nail may be deformed, thickened, discoloured (brownish yellow), and separated from the nail bed. The skin rash associated with psoriasis is dry, red, skin plaques with silver scales. These lesions are most often found on the elbow, knee, scalp, or lower back.
- *Lichen planus*. Affected nails are usually thin but they may thicken, often becoming

Page points

1. Fungal infections in the normal population can be uncomfortable and cosmetically unpleasant; however, they are unlikely to cause any serious complications.
2. In people who are immunocompromised or at risk of foot complications – such as people with diabetes – there is an increased risk of developing secondary complications, such as bacterial infections, foot ulceration, paronychia, cellulitis, and an increasing risk of lower limb amputation.
3. The prevention, identification, and management of fungal foot infections is particularly important in immunocompromised individuals.

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grooved and ridged; they may be discoloured and separate from the nail bed. The nails may shed, stop growing altogether or, in rare cases, completely disappear. Lichen planus has many forms and affects the skin and mucous membranes. The skin rash of the classical form has shiny, flat-topped, firm papules varying from pinpoint to larger than a centimetre in diameter; lesions are purple and often crossed by fine white lines (Wickham striae).

- **Eczema.** Affected nails are ridged and thickened; the skin is dry and reddened, and itchy or painful.
- **Other diagnoses.** These include the following (not exhaustive): bacterial infection; onychogryphosis (Ram's horn dystrophy, where the nail is thickened as a result of trauma and neglect, common in the elderly); onycholysis (separation of the nail painlessly from the nail bed); verruca; and subungual melanoma (pigmentation extends onto the nail fold).

6 Management of fungal foot infections. Management is tailored to the fungal infection diagnosed and the part of the foot affected:

- Dermatophyte infection of the skin; treatment is usually topical 1% terbinafine once- or twice-daily for a week^[3,11,12]. Terbinafine is fungicidal (kills the fungus) as opposed to fungi static (prevents fungal development). If the infection is intractable, consider oral terbinafine.
- Dermatophyte of the nail; use oral terbinafine 250 mg once-daily for 3–6 months^[11,12,13].
- Nail infections with non-dermatophyte moulds (*Aspergillus* species) or *Candida* species; use oral itraconazole (given as pulsed therapy – three courses of 7 days per month).

Note that liver impairment may occur with terbinafine and itraconazole.

7 Considerations for infection management in people with diabetes. People with diabetes should follow the same guidelines for foot infection management as the general population. However, Tan and Joseph^[14] suggest that people with diabetes tend to be more resistant to treatment with traditional antifungal regimens because of hyperglycaemia and difficulty maintaining

good foot hygiene (usually as a result of neuropathy, obesity, or retinopathy).

8 Considerations for polypharmacy. There are many potential interactions that must be considered when prescribing oral therapies for the treatment of fungal infections. Grant et al^[15] identified that many people with diabetes experience polypharmacy; the risk of drug interactions must be considered, as well as increasing an already large pill burden for people with type 2 diabetes.

9 Monitor treatment progress. When a normal area of nail appears near the proximal nail fold, it is likely that the nail is responding to the treatment. Consider discontinuing treatment about 4 weeks after this normal area appears. After completing treatment, consider resampling the nail if its appearance still suggests infection, although nail appearance does not always return to normal after the infection has been cured.

10 Strategies for fungal infection prevention^[6]:

- Maintain good foot hygiene and treat any mild tinea pedis before the infection spreads.
- Wear well-fitting shoes, without high heels or narrow toes. Keep the shoes dry; this can be achieved by not wearing the same shoes on a daily basis – it would be better to alternate them. Replace old shoes that may have become colonised.
- Wear clean, absorbent socks, preferably from natural fibres, such as cotton.
- When in communal areas, try and avoid contact with flooring by wearing slip-on shoes, such as flip-flops.

CONCLUSION

Fungal foot infections are common, and the treatment of them has improved significantly over the years. In healthy populations they cause few problems, but in individuals who have comorbidities, such as diabetes and chronic wounds, the risk of synergistic bacterial and fungal infections are high.

The need for early identification, followed up by microbiological confirmation and aggressive treatment is important in preventing these seemingly minor problems becoming a potential catastrophe. The role of prevention through the adoption of good, sensible foot hygiene should also not be overlooked. ■