

Figuring Out Dermatological Fungal Infections



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Presented at the University of Calgary's Wednesday Evening Course Program, Calgary, Alberta.

Superficial dermatological fungal infections are caused by dermatophytes. Dermatophytes are keratophilic superficial fungal infections that typically involve the skin, nails and hair. Dermatophytes can be classified by:

- Distribution
- Source of infection
- Taxonomy (genus of organism)

Distribution

Dermatological fungal infections can be divided accordingly:

- *Tinea capitis* (affects the scalp)
- *Tinea barbae/faciei* (affects the beard/face)



Figure 1. *Tinea capitis* (also known as black dot ringworm) caused by *Trichophyton tonsurans*.

- *Tinea corporis* (affects the trunk, arms, legs)
- *Tinea manuum* (affects the hands)
- *Tinea cruris* (affects the groin)
- *Tinea pedis* (affects the feet)
- *Tinea unguum* (onychomycosis) (affects the nails)

Sources of infection

There are three main sources by which dermatological fungal infections are spread: human-to-human (anthropophilic), animal-to-human (zooiphilic) and soil-to-human (geophilic).

Taxonomy

There are three genera of dermatophytes that can be differentiated by fungal culture characteristics. These are:

1. *Trichophyton* (most common)
2. *Microsporum*
3. *Epidermophyton*

Tinea capitis

Tinea capitis (also known as scalp ringworm) appears in three forms. Non-inflammatory *tinea capitis* resembles seborrheic dermatitis. Inflammatory *tinea capitis* (which includes kerion celsi reactions) presents with erythema, scaling



Figure 2. Tinea corporis. Caused by *Microsporum canis* from an infected kitten.



Figure 3. Tinea corporis with a Majocchi granuloma caused by *Trichophyton rubrum*. (Note the follicular spread in a patient treated with a potent topical corticosteroid).

and broken hairs. Black dot tinea capitis describes hairs that break off shortly after exiting the scalp due to fungal spores inside the hair shafts (endothrix infection).

The most common cause of tinea capitis in North America is *Trichophyton tonsurans* (anthropophilic), primarily affecting African-American children.

Tinea corporis

Tinea corporis (commonly referred to as ringworm) clinically presents as annular lesions with scale at the erythematous borders. It characteristically spreads centrifugally, often with central clearing.

Tinea cruris

Tinea cruris (described as jock itch) is similar to tinea corporis but occurs in the groin area and on the buttocks.

Tinea pedis

Tinea pedis (also known as athlete's foot) presents with interdigital and subdigital erythema

and scaling, especially prominent between the third and fourth webspaces and often involves the soles while sparing the dorsa of feet.

Tinea unguium

Tinea unguium (called onychomycosis) has a prevalence in the Canadian population of 6.48% based on a study of 15,000 patients.¹ Onychomycosis has a toenail-to-fingernail involvement of 10:1.

Clinical types of onychomycosis

Approximately 90% of onychomycosis is distal and lateral subungual in form, often presenting with yellow or brown discoloration of the nail and with a thickening of the nail plate. Onycholysis develops with subungual hyperkeratosis as the dermatophyte enters under the nail plate, either distally and/or laterally.



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Table 1

Topical and systemic treatments of dermatophytes

| | Azoles (fungistatic) | Allylamines (fungicidal) | Other |
|-----------------|--|--------------------------|---|
| Topical | Miconazole Clotrimazole Ketoconazole Oxiconazole Econazole | Terbinafine | Ciclopirox olamine (fungicidal) Tolnaftate Haloprogin |
| Systemic | Ketoconazole Itraconazole Fluconazole | Terbinafine | Griseofulvin (fungistatic) |

Proximal subungual onychomycosis is rare and presents with discolouration and proximal subungual hyperkeratosis. It is often associated with immunosuppression and HIV infection.

Superficial white onychomycosis presents with whitish scaling on the surface of the nail plate and is most commonly caused by *Trichophyton mentagrophytes*.

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Investigating dermatophytes

It is most important to establish a definite diagnosis of a dermatophyte. This is done by fungal scrapings, or in the case of onychomycosis, clipping back the affected nails and scraping the subungual hyperkeratosis and debris of the nail bed as proximally as possible. If tinea capitis is suspected, hair should also be sent, in addition to scale, for examination.

The scrapings are sent to a mycological lab where they are viewed after 10% potassium hydroxide (KOH) is applied to clear the keratin. Visualization of fungal hyphae is reported as a positive KOH and the results are usually available in a few days.

The scrapings are also cultured on Sabouraud's agar and when a dermatophyte grows, the genus and species of the dermatophyte can be identified. This result is usually available in three to four weeks.

Although a positive KOH is very suggestive of a dermatophyte, a positive fungal culture is definitive and is the gold standard for diagnosing dermatophyte infections.

Treating dermatophyte infections

Dermatophyte infections can be treated with topical or systemic antifungal agents (Table 1). Some indications for the systemic therapy of dermatophyte infections are:

- Extensive skin infections
- Skin infections failing to respond to appropriate topical therapy
- Scalp infections
- Majocchi granulomas
- Onychomycosis with multiple nails involved (more than three), > 50% of the nail plates are involved, or there is lunula (matrix) involvement

Topical treatment

Treat dermatophyte infections with topical antifungal creams until the skin is clear (this usually consists of three to four weeks of treatment with azoles and one to two weeks with terbinafine cream) and for one additional week after skin is clinically clear.

For onychomycosis, the only approved topical therapy is 8% ciclopirox in a penetrating nail lacquer. This is applied to the affected nails for 48 weeks q.h.s. The mean mycologic cure rate for toenail onychomycosis with the lacquer is 53%.²

Systemic treatment

Oral griseofulvin is no longer available in Canada and has been replaced by oral imidazoles (ketoconazole), triazoles (itraconazole and fluconazole) and allylamines (terbinafine is the only oral allylamine available in Canada).

Tinea capitis

Treating tinea capitis consists of using 250 mg of oral terbinafine q.d. for two to four weeks in

Take-home message

- Always do fungal scrapings of scaly skin lesions and fungal clippings of dystrophic nails and send for potassium hydroxide (KOH) and fungal culture to positively establish a diagnosis of a dermatophyte infection
- Not all ringed lesions are ringworm or dermatophyte infections. Many annular lesions occur in dermatology including: nummular eczema, granuloma annulare and erythema annulare centrifugum. When in doubt, take scrapings for KOH and fungal culture
- Not all dystrophic finger and toenails are due to dermatophytes. Skin disease (e.g., psoriasis and lichen planus in nails) can simulate onychomycosis. Also saprophytic fungi can look identical to onychomycosis but will not respond to the usual therapies. Again, confirm all suspected cases of onychomycosis with KOH and fungal culture, especially as treatment can involve long-term therapy with oral drugs that can cause side-effects
- Avoid combination therapies containing antifungal and potent topical corticosteroids. The immunosuppressive effect of the corticosteroid can overcome the antifungal effect, driving the dermatophyte down hair follicles (Majocchi granuloma) or altering the clinical appearance of the lesion, losing its annular appearance (tinea incognita)

Tinea unguum (called onychomycosis) has a prevalence in the Canadian population of 6.48% based on a study of 15,000 patients.

adults and 5 mg/kg q.d. in children (the easiest dosing schedule is < 20 kg, 62.5 mg q.d., 20 kg to 40 kg, 125 mg q.d. and > 40 kg, 250 mg q.d.).

Tinea corporis, tinea cruris and tinea pedis

For extensive tinea corporis or tinea cruris in adults, use 250 mg of oral terbinafine q.d. for one to two weeks.

Persistent tinea pedis can be treated with 250 mg of oral terbinafine q.d. for two to four weeks if topical treatment has failed.

Alternate oral therapy for tinea corporis/cruris is 200 mg of oral itraconazole q.d. for one week or 100 mg q.d. for two weeks.


For tinea pedis/tinea manuum, alternate oral therapy includes pulsed itraconazole in a dose of 200 mg b.i.d. for one week. Continuous therapy is dosed at 200 mg q.d. for two weeks or 100 mg q.d. for four weeks.

The mean mycologic cure rate for toenail onychomycosis with oral terbinafine is 75%.

Onychomycosis

Fingernails respond much better than toenails to treatment and toenail onychomycosis is much more likely to relapse after therapy.

Oral terbinafine therapy for onychomycosis is 250 mg q.d. for six weeks for fingernails and 250 mg q.d. for 12 weeks for toenails. The mean mycologic cure rate for toenails with oral terbinafine is 75%.²

Alternately, oral itraconazole pulse therapy can be used. The dose is 200 mg b.i.d. for one week per month, with one week on and three weeks off between pulses. Two pulses are used for fingernails and three pulses for toenails. The mean mycologic cure rate for toenails with oral itraconazole is 60%.² 

References

1. Gupta AK, Jain HC, Lynde CW, et al: Prevalence and Epidemiology of Onychomycosis in Patients Visiting Physicians' Offices: A Multicenter Canadian Survey of 15,000 Patients. *J Am Acad Dermatol* 2000; 43(2 Pt 1):244-8.
2. Gupta AK, Lynde CW, Barber K: Pharmacoeconomic Assessment of Ciclopirox Topical Solution, 8%, Oral Terbinafine and Oral Itraconazole for Onychomycosis. *J of Cutan Med Surg* 2006; 10(Suppl 2):S54-S62.