Superficial fungal infections

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Background
Tinea is a common fungal infection that can affect the skin, nails and hair. Tinea infection has a variety of clinical manifestations and affects all age groups, ranging from tinea pedis in adults to tinea capitis in pre-pubertal children.

Objective
This article provides an updated overview of the common clinical manifestations and practical approaches to the diagnosis and management of tinea infections.

Discussion
While tinea may be suspected on the basis of clinical grounds, it is important to be aware of the various conditions considered in the differential diagnosis that may mimic tinea infections. Topical and systemic antifungal modalities are available and are selected on the basis of the subtypes and severity of tinea infection. Untreated, tinea can cause significant morbidity and predispose to complications, including cellulitis and ulcers on the feet and alopecia on the scalp.

SUPERFICIAL FUNGAL INFECTIONS are caused by dermatophytes in the Microsporum, Trichophyton and Epidermophyton genera.1 Dermatophytes live on keratin, which is found in skin, hair and nails. There is evidence that continuing migrations and mass tourism contribute to the changing epidemiological trends.2,3 Tinea infections are named according to the Latin term that designates the anatomic site of infection, such as tinea capitis (scalp), tinea corporis (body), tinea manuum (hand), tinea cruris (groin), tinea pedis (foot) and tinea unguium (nail).

Clinical manifestations
Tinea pedis
Tinea pedis, colloquially known as ‘athlete’s foot’, is the most common dermatophyte infection. Its prevalence increases with age; it is rare in children.4 Exposure to occlusive footwear, sweating and communal spaces are predisposing factors of tinea pedis.5 The interdigital subtype is the most common form of tinea pedis, which manifests as maceration or scales between toes (Figure 1).7 Another subtype is the chronic hyperkeratotic (moccasin-type) tinea pedis, which is characterised by chronic plantar erythema with scaling involving the lateral and plantar surfaces of the foot (Figure 2). The dorsal surface is usually spared in this subtype. A less frequent presentation of tinea pedis is the vesiculobullous or inflammatory form, which may sometimes be difficult to clinically distinguish from pompholyx eczema.8 Recurrent tinea pedis may be due to a reservoir of untreated tinea in the nails.
**Tinea unguium (onychomycosis)**

Tinea unguium, also known as onychomycosis, is a dermatophyte infection of the nails. Onychomycosis is very common in the elderly with a prevalence of up to 50% in people aged over 70 years. Nearly half of patients with toenail onychomycosis were found to have concomitant fungal skin infections, most commonly tinea pedis. The most common clinical subtype is the distal lateral subungual onychomycosis that appears as yellowish or brownish discoloration associated with onycholysis and subungual hyperkeratosis (Figure 3). The other common subtype is the white superficial onychomycosis, which has the appearance of white spots on the nail plate that can involve the entire nail if not treated. Onychomycosis has many mimics (Table 1), so it is important to establish a mycological diagnosis before commencing therapy. Individuals with underlying nail disease are at increased risk of concomitant onychomycosis. Immunocompromised and diabetic hosts are not only at a greater risk of onychomycosis but are also more susceptible to the bacterial complications of onychomycosis, such as cellulitis.

**Tinea capitis**

Tinea capitis is a dermatophyte infection of the scalp and hair and it predominantly occurs in pre-pubertal children. The three main clinical presentations of tinea capitis are scaly patches with alopecia, alopecia with black dots at the follicular opening and diffuse scalp scaling with subtle hair loss. A severe form of tinea capitis is referred to as ‘kerion’, which is characterised by a tender plaque with pustules and crusting. If untreated, kerion may cause permanent scarring and alopecia. Cervical lymphadenopathy is a common associated finding in patients with tinea capitis.

**Tinea corporis and tinea cruris**

Tinea corporis, commonly known as ringworm, refers to a dermatophyte infection on the skin of sites other than face, hands, feet or groin. Tinea cruris is also known as ‘jock itch’ and occurs in the groin fold and is more frequent in adult men. Tinea corporis most commonly occurs in children and young adults. Tinea corporis (Figure 4) and tinea cruris (Figure 5) classically present as annular plaques with central clearing and leading scale. The lesions may be single or multiple and of varying sizes, which may coalesce. Pustules or vesicles can sometimes occur at the active edge.

Although tinea infection is common, it is important to consider many other causes of an annular rash as described in Table 2.

**Tinea incognito**

Tinea incognito is a term for a tinea infection that has been misdiagnosed and inappropriately treated with a topical corticosteroid or other immunosuppressive agents. The clinical features may become masked with attenuated scale and erythema, as well as a less well-defined border (Figure 6). The infection may also be exacerbated as the dermatophytes invade the dermis or subcutaneous tissue causing deep-seated folliculitis, also referred to as Majocchi’s granuloma.

**Practical approach to diagnosis**

A diagnosis of tinea infection may be suspected on the basis of clinical history and examination. Since many conditions can mimic tinea infections,
it is recommended that investigations are performed to confirm the diagnosis. Although minor localised infections may be treated with empirical topical therapy, testing should be performed prior to commencing systemic therapy. Without the diagnostic confirmation, prescribers may not know when to stop the therapy.

In recurrent cases of tinea, it is essential to identify any potential reservoir for dermatophytosis. Toenails are a common reservoir for tinea and can result in recurrent tinea pedis as well as transmission by autoinoculation to other body parts, such as the hand and groin.\(^{14,15}\) As it is common for dermatophytes to concurrently affect more than one body part at the same time, a full skin examination should be performed to determine the extent of involvement and potential reservoir. In addition, animals may also be reservoirs. *Microsporum canis* is the most common dermatophyte isolate in tinea capitis, with cats and dogs recognised as important natural hosts.\(^{16}\) In these cases, animals should be tested and treated until mycological cure, to prevent reinfection in humans.

### Diagnostic tests

Tinea infection can be diagnosed using fungal microscopy and culture, which allows for fungal speciation and viability assessment. Fungal microscopy of skin scrapings and nail clippings is performed on KOH (potassium hydroxide) and can be rapid. Fungal culture can take up to four to six weeks and but has a false-negative rate of at least 30% for nail samples.\(^{17}\) Repeat culture should be performed if there is a high index of clinical suspicion.

#### Advice on specimen collection

- Prior topical antifungal therapy may lead to false-negative culture results.
- Topical corticosteroid cream generally does not affect the isolation of dermatophytes but it can make it difficult to collect sufficient specimen. The cream should be wiped off prior to scraping.
- Each site needs to be collected in separately labelled containers to allow correct identification of the infective sites.
- Collect as much specimen as possible to maximise the yield.
- For skin scrapings:
  - Use a scalpel blade, held at an angle.
  - Always sample from the active leading edge of the lesion. Fungi are rarely identified from the interdigital macerated samples or the centre of the lesion. The moist interdigital areas of the feet are usually colonised with concomitant bacterial isolates, such as *beta-haemolytic streptococci*, *Staphylococcus aureus* and *Pseudomonas aeruginosa*.\(^{18}\)
- For nail clippings/scrapings:
  - Use a nail clipper to clip the infected portion of the nail plate.
  - In addition to the nail plate sample, collect as much subungual debris

### Table 2. Think beyond tinea: Differential diagnosis of tinea corporis (annular rash)\(^{12}\)

<table>
<thead>
<tr>
<th>Differential diagnosis</th>
<th>Clinical features</th>
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<tbody>
<tr>
<td>Discoid eczema (nummular)</td>
<td>• Less likely to have central clearing (but can occur)</td>
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<tr>
<td></td>
<td>• More confluent scales</td>
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<tr>
<td>Annular psoriasis</td>
<td>• Silvery scale</td>
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<tr>
<td></td>
<td>• Nail pitting</td>
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<td></td>
<td>• Family history of psoriasis</td>
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<tr>
<td>Pityriasis rosea</td>
<td>• Herald patch progressing to generalised rash</td>
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<td>Subacute cutaneous lupus erythematosus</td>
<td>• More common in females</td>
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<td></td>
<td>• Photosensitive areas</td>
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<tr>
<td>Erythema annulare centrifugum</td>
<td>• Trailing scale rather than leading scale in tinea</td>
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and as far proximally as is painless using a curette or scalpel blade.

- For a hair specimen:
  - Use forceps or a brush to collect infected hair. Ensure to collect the hair root and scrape the area using a scalpel blade. Infected hairs usually come out easily.
  - For small children, an alternative method is to use a sterile moistened cotton swab, which has been shown to be an equally reliable and atraumatic technique.19

**Treatments modalities**

The mode of treatment depends on the extent and location of the tinea infection. General tips for the management of tinea infection are listed in Box 1. Systemic therapy with oral terbinafine and azoles is summarised in Table 3.

**Topical antifungal therapy**

Most cases of tinea corporis, tinea cruris and tinea pedis are amenable to topical therapy. Recommended first-line topical therapy is terbinafine 1% cream once or twice daily for one to two weeks.20

In cases of onychomycosis with contraindication to systemic therapy, nine to 12 months of ciclopirox 8% nail lacquer once daily or amorolfine 5% nail lacquer once daily with debridement of hyperkeratotic nails can be offered but has low mycological cure rates of 29–36%21 and 38%,22 respectively.

**Oral antifungal therapy**

Oral therapy should be considered in the following scenarios:

- onychomycosis
- tinea capitis

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**Table 3. Head-to-head comparison of oral terbinafine versus azoles in onychomycosis treatment**20,23,24,39–41

<table>
<thead>
<tr>
<th>Terbinafine</th>
<th>Azoles (fluconazole and itraconazole)</th>
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<tr>
<td><strong>Recommended line of therapy</strong></td>
<td><strong>First line</strong></td>
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<tr>
<td><strong>Dosage</strong></td>
<td>Adult: 250 mg daily</td>
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<td></td>
<td>Child &lt;20 kg: 62.5 mg daily</td>
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<td></td>
<td>Child 20–40 kg: 125 mg daily</td>
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<tr>
<td></td>
<td>Duration: Six weeks for fingernails, 12 weeks for toenails</td>
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<tr>
<td><strong>Recurrence rate (follow-up 10–13 months)</strong></td>
<td>33.3%</td>
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<tr>
<td><strong>Adverse effects</strong></td>
<td>Gastrointestinal upset, rash, headache, myalgia</td>
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<tr>
<td><strong>Recommended monitoring</strong></td>
<td>Routine interval blood monitoring may be unnecessary in healthy adults and children without underlying hepatic or haematological conditions</td>
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<tr>
<td><strong>Precautions</strong></td>
<td>Psoriasis and lupus may be exacerbated by terbinafine</td>
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<tr>
<td></td>
<td>Contraindicated in severe hepatic disease</td>
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<td></td>
<td>Dose adjustment required if CrCl &lt;50 mL/min</td>
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**Pregnancy categorisation**

- Category B1
- Fluconazole: Category D
- Itraconazole: Category B3

**Breastfeeding compatibility**

- Avoid, insufficient data
- Fluconazole: compatible; may cause diarrhoea in infant
- Itraconazole: avoid, insufficient data
extensive tinea on the skin
failed topical treatment
immunocompromised patients.
Recommended first-line oral therapy for terbinafine 250 mg once daily for adults.20 Refer to Table 3 for paediatric dosing. Terbinafine is generally safe for use in healthy patients without the need for interval blood monitoring.23 However, it is contraindicated for patients with severe liver impairment and dose reduction is required for patients with moderate-to-severe chronic kidney disease (CrCl <50 mL/min).20

The duration of oral therapy depends on the site:
- scalp: four weeks
- fingernails: six weeks
- toenails: 12 weeks (longer duration therapy is required because of diminished blood supply in the area, especially in the elderly)
- other than scalp and nails: two weeks.

A 2017 Cochrane review24 showed that terbinafine is superior to fluconazole for both clinical and mycological cure of onychomycosis and itraconazole for both recurrence and adverse events.

Griseofulvin for six to eight weeks (paediatric dosing: 10 mg/kg up to 500 mg) is first-line therapy for tinea capitis caused by Microsporum infections.20 In contrast, griseofulvin is recommended as third-line therapy for tinea corporis because it is less effective than terbinafine and azoles for this indication.20 Griseofulvin is generally not recommended for onychomycosis as it has a longer treatment duration, higher rate of adverse events and is not more effective than terbinafine and azoles.24 Griseofulvin dosages vary depending on its indications: 500 mg once daily is recommended for tinea capitis, tinea corporis and tinea cruris; 1 g once daily is recommended for tinea pedis and onychomycosis.28

### Laser therapy

The cure rates for laser therapy in onychomycosis are significantly lower than those for topical and oral therapies.26,27 Given its limited efficacy and high cost, laser therapy cannot be recommended as first-line treatment for onychomycosis.28

### Prevention of recurrence

After therapy for onychomycosis, there may be a recurrence or reinfection rate of up to 25%.29,30 Patients should be advised to address modifiable risk factors for prevention of tinea infection, including avoiding sharing hairbrushes, clothes or shoes; avoiding walking barefoot around public showers and pools; and regularly alternating footwear and changing socks.

Following a cure, topical antifungal therapy (ciclopirox, amorolfine, bifonazole, terbinafine) can be applied weekly as prophylaxis. This method has been shown to significantly lower the recurrence rate in a retrospective study.31 The optimal duration of prophylaxis is unclear and may be indefinite.

### Conclusion

Tinea is a common infection in the general community. It is a diagnosis that is frequently missed unless we think of it and test for it. Prompt recognition and management of tinea infection help reduce morbidity and its associated complications, as well as reducing the chance of transmission. The location and severity of tinea infection determine the empirical treatment modality and duration. As there are many mimics of tinea, clinicians should not prescribe oral antifungal therapy without a confirmed diagnosis.

### References
