The diagnosis and management of tinea

Blaithin Moriarty, Roderick Hay, Rachael Morris-Jones

Tinea refers to superficial infection with one of three fungal genera—Microsporum, Epidermophyton, and Trichophyton—collectively known as dermatophytes. These infections are among the most common diseases worldwide and cause serious chronic morbidity. Griseofulvin treatment and school screening programmes almost eradicated tinea capitis (scalp infection) as an endemic condition in the developed world in the 1950s, but it re-emerged as a public health problem in the United Kingdom in the 1990s, with infection rates of at least 12% in school children. Increased mass tourism and mobile populations may have contributed to the changing epidemiological trends. Newly developed polymerase chain reaction based techniques, although useful in rapid diagnosis of dermatophyoses, are still not widely available. Although the number and range of antifungal drugs are limited compared with antibiotics, most are highly effective for fungal disease acquired in temperate climates. This review aims to familiarise the reader with the various clinical presentations of tinea, to outline the steps that should be taken for accurate diagnosis, and to evaluate the most appropriate treatment regimens.

What is tinea?
All three genera of dermatophytes grow in keratinised environments such as hair, skin, and nails. Anthropophilic dermatophytes are restricted to human hosts and produce mild chronic inflammation. The main reservoirs of zoophilic dermatophytes are pets, livestock, and horses; infection with such organisms usually causes marked inflammatory reactions in humans. Geophilic dermatophytes, from soil, only occasionally infect humans and animals.

What are the most common types of dermatophytes?
T. rubrum, which takes its name from the underside of cultured colonies being red, is the most common anthropophilic dermatophyte. It is the main pathogen implicated in the increasing global incidence of onychomycosis, tinea corporis, tinea cruris, tinea manuum, and tinea pedis in the UK, Europe, and the United States. Infection with T. interdigitale is a common cause of tinea pedis worldwide, with higher rates seen in some regions such as the Far East; this species is less common at other sites. T. tonsurans has been the main cause of tinea capitis in London since the mid-1990s, and it continues to increase in incidence in the US and elsewhere. It has an endothrix pattern of infection—the fungus penetrates into the hair shaft so systemic treatment is necessary. E. floccosum is the only Epidermophyton species known to be pathogenic in humans. It causes a small number of cases of tinea pedis and tinea cruris. M. canis is a zoophilic organism that normally affects household pets. Infections caused by M. canis, such as tinea capitis, may be highly inflamed and are often accompanied by erythema and pustules. The incidence of this infection is rising in central and southern Europe; it also occurs in the UK.

Tinea capitis
Dermatophyte infection of the scalp is known as tinea capitis (fig 1). Tinea capitis is almost exclusively a disease of childhood, and current evidence suggests that it occurs more often in children of African or Caribbean extraction. It is largely caused by T. tonsurans in cities in the UK, by M. canis in Europe and rural UK, and by T. violaceum in east Africa and the Indian subcontinent. Clinical signs may be subtle, with mild flaking of the scalp alone; however, broken-off hairs ("black dot" ringworm), patches of frank alopecia, pustules, large

SUMMARY POINTS
Tinea is increasingly a problem worldwide
Tinea may affect any body site and is named according to the anatomical area infected
Pathogenic organisms have a variable geographical distribution
Mycology samples should be taken before and after appropriate treatment

Fig 1 | Tinea capitis. Two of this boy’s siblings developed patchy hair loss over three months, whereas three did not. All five children were positive for Trichophyton tonsurans on mycological culture from brushings. All were treated simultaneously with oral terbinafine for one month and had complete hair regrowth. Repeat brushings after treatment showed no evidence of ongoing infection
inflammatory swellings (kerion), and tender occipital lymphadenopathy may also occur. Five distinct patterns of clinical infection are described (box 1). Infection is often asymptomatic and undiagnosed, with consequent spread to close contacts, especially siblings, who should be screened.

Infection is often asymptomatic and undiagnosed, with consequent spread to close contacts, especially siblings, who should be screened. T. tonsurans may be isolated from the personal belongings of children with tinea capitis, and sterilisation of fomites, such as hairbrushes and combs, is recommended. Adults rarely have tinea capitis, although they may develop tinea corporis (of the head or neck) through spread from a child’s scalp. Exclusion of infected children from school is no longer advised.

Disseminated eczema-like (“id”) reactions occasionally occur with inflammatory tinea, usually at the start of systemic antifungal treatment.

Tinea unguium
Tinea unguium, a dermatophyte infection of the nails, is also known as onychomycosis (fig 2). In general nail plates are discoloured and may be thickened, brittle, or distorted and show onycholysis (lifting of the nail plate). Five major presentations of tinea unguium are currently recognised: distal and lateral subungual, proximal subungual, superficial white, endonyx, and total dystrophic onychomycosis, although a recent review has proposed refining this classification to help focus treatment according to species.

The prevalence of onychomycosis is at least 12.4% in Europe, and the disease is often atypical and aggressive in patients with untreated HIV infection. Onychomycosis of the toenails is more common than disease of the fingernails. Patients with psoriasis have an increased risk of onychomycosis because the abnormal psoriatic nail provides a portal for fungal entry. Because the two conditions may be clinically similar, laboratory confirmation is necessary before the start of oral treatment and should be repeated at the end of treatment. Failure to do this can result in unnecessary or unnecessarily long treatment regimens, because psoriatic nail dystrophy does not respond to antifungals. HIV may predispose to more frequent and severe infection and failure to respond to conventional doses of antifungals.

Tinea pedis
Tinea pedis (fig 3), dermatophytosis of the feet, commonly presents with scaling and maceration of the most lateral interdigital spaces extending medially. In addition, hyperkeratosis of the plantar and lateral aspect of the foot may be seen in

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**Box 1 | Presentations of tinea capitis**
- Diffuse scale: Similar in appearance to dandruff; may initially be masked with hair oils
- Grey patches with alopecia: Circular patches with marked scaling may be seen
- Black dots: Sites of broken-off hairs within patches of alopecia; seen mainly in endothrix infection
- Kerion: Often presents emergently with boggy, localised swelling. It is caused by an aggressive inflammatory response to the organism and may be accompanied by cervical lymphadenopathy
- Diffuse pustular lesions: Widespread scattered pustules; may have scanty organisms
the so-called moccasin or dry-type pattern of infection. A less common presentation is with small vesicles and blisters on an erythematous base on the plantar surface of the feet, and these lesions look similar clinically to pompholyx eczema. The prevalence of tinea pedis is high, particularly in people who wear occlusive footwear, such as athletes.

**Tinea corporis and tinea cruris**

Tinea corporis and tinea cruris refer to dermatophytosis of the trunk and groin, respectively. Both present with a pruritic erythematous rash with an active scaly palpable edge within which pustules or vesicles may be seen (fig 4). The infection spreads centrifugally and results in annular patches of varying sizes, usually asymmetrical in distribution. Tinea corporis is seen most commonly in children and young adults, whereas tinea cruris is more common in adult men.

**Tinea manuum**

Although dermatophytosis of the hand is usually unilateral, it can be bilateral (fig 5). Infection of the dorsum of the hand is similar to tinea corporis in morphology, although infected palmar surfaces usually have a dry scaling appearance. An entity known as “one hand, two foot syndrome” describes tinea in this asymmetrical distribution, with the dominant hand being more commonly affected.

**Tinea faciei and tinea barbae**

Tinea faciei refers to dermatophytosis anywhere on the face, whereas tinea barbae refers specifically to infection within the beard area. Both entities occur in postpubertal boys and men in a pattern similar to that seen for tinea capitis. Zoophilic organisms such as *T verrucosum* or *T mentagrophytes* are the most common pathogens implicated, produce an inflammatory pustular eruption with crusting or kerion formation; *T tonsurans* is an increasingly common cause of a similar problem in wrestlers. The term tinea faciei encompasses both this presentation and the classic annular scaly eruption.

**Tinea incognito**

Superficial cutaneous dermatophytosis can be difficult to distinguish from other inflammatory dermatoses listed in table 2. Topical steroids may alter the morphology of tinea, with flattening of the edge and loss of surface scale (fig 6), making the clinical diagnosis difficult (hence the term tinea incognito). A large retrospective study of tinea incognito in children found that the face or trunk were most commonly affected and that *T mentagrophytes* was the most common organism.

**How is tinea diagnosed?**

**History**

Take a careful history to estimate the duration of symptoms, previous treatments, and affected contacts. Look for a history of exposure to pets—such as dogs, cats, or hamsters—with rashes.

**Examination**

Perform a full skin examination focusing on the affected sites. Tinea infections are often asymmetrical in distribution. Morphology is usually scaly with erythema, although the characteristic scaly edge is masked in moist flexures. Differing presentations are seen in the scalp, including a diffuse scaling, black dot ringworm (where hairs break close to the scalp skin), alopecia areata-like hair loss, and kerion. Spread of scaly patches to the upper trunk and limbs may be seen in children with tinea capitis as well as occipital or cervical lymphadenopathy. The toenails and interdigital toeweb spaces are often infected in patients who have tinea at other sites, such as the groin, and should be examined.

**Diagnostic tools: Wood’s light**

Wood’s light is a lamp filtered by Wood’s glass (barium silicate containing 9% nickel oxide that transmits rays of a wavelength >365 nm) which, when directed on tinea...
How are samples taken for mycological analysis?

Scalp brushings
An excellent way to collect scaly material is with a disposable travel toothbrush that is brushed briskly over visibly affected areas of the scalp. The brush is then sent for mycological culture. Alternatives include dampened swabs or scrapings (table 1).

Scrapings
A blunt instrument such as the back of a scalpel blade is useful for obtaining scales from the active edge of a suspected tinea infection. The material collected should be transported in dark paper to the mycology laboratory for microscopy and culture. Do not use plastic containers, such as sterile specimen jars, because the scale sticks to the plastic (owing to static electricity).

Nail clippings
When nail infection is suspected, include nail clippings and subungual debris in the sample (usually transported in dark folded paper) for microscopy and culture. Because the yield is unpredictable take as much material as possible.

Are swabs useful in tinea?
Swabs for mycology culture are particularly useful when sampling fungal kerions and in pustular or macerated infections.

Interpreting results of traditional mycological tests
Direct microscopy can be performed immediately, and most laboratories report the presence or absence of fungal hyphae or yeasts within 24 hours. Because scalp brushings are usually transported on a brush, microscopy cannot be performed. Regardless of the collection method and microscopy result all samples are cultured on agar for identification, which takes at least two weeks. A negative culture result cannot be confirmed until plates have been incubated for six weeks. Treatment of clinically obvious or severe cases should not be delayed for culture results, although treatment may need to be altered according to the dermatophyte grown. The presence or absence of fungal elements on microscopy is not always predictive of positive culture.
Table 2 | Diagnosis and treatment of tinea

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Infectious agents</th>
<th>Clinical manifestations</th>
<th>Differential diagnosis</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tinea barbae</td>
<td>Trichophyton verrucosum, T. mentagrophytes</td>
<td>Infection of the beard area in adult men; usually inflammatory and pustular with crusting</td>
<td>Effects of shaving, folliculitis, Staphylococcus aureus infection, impetigo</td>
<td>Oral terbinafine 250 mg daily for 4 weeks; itraconazole 200 mg daily for 2 weeks</td>
</tr>
<tr>
<td>Tinea capitis</td>
<td>T. tonsurans, Microsporum canis, M. audouinii, T. verrucosum, T. violaceum, T. soudanense</td>
<td>Infection of the scalp causing scalp scale, itch, pustules and less often kerion, may cause secondary alopecia; eyebrows and eyelashes may also be affected</td>
<td>Atopic eczema, sebomycotic dermatitis, psoriasis, discoid lupus erythematosus</td>
<td>Oral terbinafine 250 mg daily for 4 weeks in adults; children (depends on weight) 62.5 mg daily if &gt;20 kg, 125 mg daily if 20-40 kg, 250 mg daily if &gt;40 kg (all for 4 weeks)</td>
</tr>
<tr>
<td>Tinea corporis</td>
<td>T. rubrum, M. canis, T. tonsurans</td>
<td>Infection of the trunk; pruritic erythematous lesions with central clearing</td>
<td>Annular psoriasis, discoid eczema, annular erythema</td>
<td>Topical terbinafine 1% cream for 4-6 weeks; if extensive use oral terbinafine or itraconazole</td>
</tr>
<tr>
<td>Tinea cruris</td>
<td>Epidermophyton floccosum, T. rubrum, T. interdigitale</td>
<td>Infection of the groin and pubic area; pruritic erythematous lesions with central clearing</td>
<td>Bacterial or candidal intertrigo, erythrasma, psoriasis, sebomycotic dermatitis</td>
<td>Topical terbinafine 1% cream for 2-4 weeks</td>
</tr>
<tr>
<td>Tinea incognito</td>
<td>Potentially any cutaneous dermatophytosis that has been inappropriately treated with topical steroid</td>
<td>Spreading erythema that has lost its raised palpable edge and looks more indistinct</td>
<td>Eczema, psoriasis, subacute cutaneous lupus erythematosus</td>
<td>Stop topical steroids and treat with topical terbinafine 1% cream for 6 weeks</td>
</tr>
<tr>
<td>Tinea manuum</td>
<td>T. rubrum, T. mentagrophytes</td>
<td>Infection of the hand; pruritic erythematous lesions with central clearing, often one hand (usually the dominant one) only</td>
<td>Psoriasis, eczema, contact dermatitis, keratoderma, keratolysis exfoliativa</td>
<td>Topical or systemic terbinafine for 2-4 weeks</td>
</tr>
<tr>
<td>Tinea pedis</td>
<td>T. rubrum, T. interdigitale, E. floccosum</td>
<td>Infection of the feet involving interdigital spaces and, if chronic, soles of the feet, itchy, peeling, maceration, and fissuring of toe webs</td>
<td>Psoriasis, eczema, contact dermatitis, soft corns, candida, pitted keratolysis, keratoderma</td>
<td>Topical terbinafine 1% cream 2-6 weeks</td>
</tr>
<tr>
<td>Tinea unguium (onychomycosis)</td>
<td>E. floccosum, T. interdigitale, T. rubrum, T. verrucosum</td>
<td>Infection of the nail plate; often white or yellow lesions with irregular edges; some degree of subungual hyperkeratosis, which leads to nail detachment, is usually present</td>
<td>Psoriasis, eczema, lichen planus, trauma, candida, bacterial, genetic abnormality</td>
<td>Oral terbinafine 250 mg daily for 3-6 months; itraconazole 200 mg daily for 3 months or pulsed 200 mg twice daily 7 days/month for a total of 2-3 months</td>
</tr>
<tr>
<td>Tinea versicolor</td>
<td>Malassezia spp</td>
<td>Small, scaly annular hypopigmented or hypopigmented patches on trunk or neck; when treated macular discoloration can persist for months</td>
<td>Psoriasis, eczema, vitiligo</td>
<td>Itraconazole 200 mg daily for 1 week; ketoconazole 200 mg daily for 4 weeks</td>
</tr>
</tbody>
</table>

Box 2 | Reasons for treatment failure

Poor adherence to treatment: For example, in the UK terbinafine is available only as a crushable tablet, which may be unpalatable for children

Dermatophyte resistant to drug(s): Consider changing agents if resistance is suspected, but this is very rare

Reinfection from close contacts: This should always be considered in persistent or recurrent cases and contacts should be screened

Alternative diagnoses: Tinea may mimic a variety of other conditions

Rare causes of foot infection: Travel or living abroad may lead to more exotic fungal species that are resistant to treatment being acquired

results, and if a clinician is faced with unexpectedly negative results, repeat the investigations while alternative diagnoses are considered. Collect as much material as possible from the brushings, scrapings, or clippings to ensure that samples are adequate for microscopy and culture; this increases the chance of positive mycology results.

New molecular techniques

Polymerase chain reaction based methods are emerging as useful investigations for the detection of dermatophytes, mainly in nail disease. Currently, however, these are available only occasionally as routine diagnostic procedures. One such commercially available technique, Onychodiag (BioAdvance, France), was designed to detect dermatophytes using a polymerase chain reaction enzyme linked immunosorbent assay in nail samples. In a multicentre study this had a sensitivity of 83.6% and a specificity of 100%,suggesting the importance of mycological identification in infected people. Similarly, oral itraconazole is effective in treating infections of the scalp. Oral terbinafine is the treatment of choice.
treatment of choice for most kerions, and the addition of a topical steroid reduces inflammation and allows complete hair regrowth. Children presenting with a kerion may best be managed in secondary care to ensure rapid mycological diagnosis and adequate immediate systemic treatment; additional steroid preparations are indicated to ensure recovery without permanent alopecia.

**Tinea unguium**

Topical treatment alone is rarely effective in curing onychomycosis. However, for patients in whom systemic treatment is inappropriate because of comorbidities, or where a single nail is affected, amorolfine nail lacquer can be beneficial when used twice weekly for 6-12 months. Nail infections are treated with a minimum course of systemic terbinafine or itraconazole for six weeks for fingernails and three months for toenails, combined with topical drugs and surgical or chemical nail avulsion, as clinically indicated. The regimen are terbinafine 250 mg daily or itraconazole 400 mg daily for one week each month. If onychomycosis does not respond to prolonged oral antifungal treatment (at least three months), consider alternative diagnoses for abnormal nail plates including trauma, psoriasis, and lichen planus.

**Skin infections**

Topical treatment is valuable in managing tinea infections of the skin, although systemic treatment may be needed for more severe or extensive infections. There is no evidence that any specific topical agent is superior; all should be used for two to six weeks (table 2). The first line topical agent is usually terbinafine 1% cream twice daily for four to six weeks. Creams that contain an antifungal agent plus hydrocortisone are effective for inflamed infections. Tinea pedis and tinea cruris often relapse after successful treatment in susceptible people, who should be advised to keep the affected skin dry to prevent relapse. Advise patients to consider washing or replacing potentially contaminated socks, towels, and footwear (such as training shoes) after successful treatment.

**When should referral to hospital be considered?**

Fungal skin and hair infections should respond to treatment within a few weeks and nail infections within three months. If symptoms and signs persist beyond these times consider referral to secondary care. The main causes of apparent treatment failure are incorrect diagnosis and suboptimal treatment (table 2).

**Contributors**

All authors contributed equally to the preparation of this manuscript and helped revise the final draft. RM-J is guarantor.

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None declared.

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