1 Can the diagnosis of a superficial fungal infection be made by clinical recognition alone?

Even though you may suspect a fungal infection by its clinical appearance, it's very important to confirm the diagnosis with either a potassium hydroxide (KOH) examination, a culture, or sometimes both (see Table 1, "Superficial fungal infections: a guide to Dx and Rx").

To be able to select the proper therapy and predict its effectiveness, you should have a confirmed diagnosis. Furthermore, there are fungal infections that look alike. For example, in the groin area, it's sometimes difficult to distinguish between a dermatophyte infection (tinea cruris) and a yeast infection (candidiasis).

Scalp infections are also notoriously confusing. Anytime seborrhoeic dermatitis fails to respond to treatment, especially in children, you should think of a Trichophyton tonsurans infection.

Dx: culture, KOH, Wood's light, and more

2 Is the KOH the diagnostic test of choice?

Microscopic examination of a KOH preparation is certainly indicated whenever you see scale and inflammation. It's a simple test that can be done in the surgery, and you'll have the results in minutes.

Dr. Rudolph is clinical professor of dermatology, Baylor College of Medicine, Houston, USA.

The key to a successful KOH is selecting the appropriate site and specimen for testing, especially in scalp infections.

There are two types of fungal infections of the scalp hair: ectothrix and endothrix. In both types, the KOH may reveal spores and hyphae within the individual strands of hair, but in ectothrix infections, the spores are also found on the outside of each hair.

T. tonsurans, which is probably the most common cause of tinea capitis, produces an endothrix infection. In endothrix infections, the spores are confined to the inside of the hair. Unfortunately, the infected hairs tend to break off at the scalp surface. Long hairs, which you can grasp, will not yield a positive KOH result.

In this situation, you should look for tiny black dots in the area of hair loss. These can be scraped off with a scalpel blade or needle for a KOH examination.

Getting appropriate material for testing is also crucial in tinea corporis, or ringworm infections of the body. A scraping should be taken.
# Superficial fungal infections: a guide to Dx and Rx

<table>
<thead>
<tr>
<th>Infection</th>
<th>Clinical appearance</th>
<th>Diagnosis</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Superficial mycoses</strong></td>
<td></td>
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</tr>
<tr>
<td>Tinea versicolor</td>
<td>Scaly patches on upper trunk and neck; lesions fawn to brown in winter, white in summer; may involve large area of skin</td>
<td>KOH test, Wood's light may be helpful to determine extent of involvement</td>
<td>Selenium sulphide regimen, Tinver lotion, haloprogin, or topical imidazoles for limited infections, Does not respond to griseofulvin</td>
</tr>
<tr>
<td>Tinea nigra</td>
<td>Brownish to black macular lesions on palms or soles</td>
<td>KOH test</td>
<td>Culture for <em>Exophiala werneckii</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Topical keratolytic agents, such as salicylic acid and Whitfield's ointment, Topical imidazoles, Does not respond to griseofulvin</td>
</tr>
<tr>
<td><strong>Dermatophytoses</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tinea capitis, noninflammatory</td>
<td>Patchy alopecia; broken hairs; mild scaling; minimal inflammation of scalp</td>
<td>KOH test, Culture, Wood's light: hairs infected with <em>Microsporum</em> species may fluoresce</td>
<td>Griseofulvin, Shampoo, Topical fungicides</td>
</tr>
<tr>
<td>Tinea capitis, inflammatory</td>
<td>Hair loss; inflammation and pustulation of scalp; kerions in some patients</td>
<td>KOH test</td>
<td>Culture, Wood's light: hairs infected with <em>Microsporum</em> species may fluoresce</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Griseofulvin, Moist compresses, daily shampoos, topical fungicides, systemic steroids may be required at times</td>
</tr>
</tbody>
</table>
A KOH is indicated whenever you see scale and inflammation, and the key to success is selection of the appropriate site and specimen for testing.

### Superficial fungal infections: a guide to Dx and Rx

<table>
<thead>
<tr>
<th>Infection</th>
<th>Clinical appearance</th>
<th>Diagnosis</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tinea pedis</td>
<td>May appear as: 1) dry scaling of sole and sides of foot, 2) vesicular eruption of the arch, 3) interdigital itching and scaling. Onychomycosis of toenails may be seen with all types.</td>
<td>KOH test, Culture</td>
<td>1) Topical imidazoles or haloprogin in mild cases; add griseofulvin for chronic infections; keratolytic agent may be needed. 2. 3) Griseofulvin plus topical imidazoles; with superimposed bacterial infection, moist compresses, bed rest, and systemic antibiotics may be required. Keep feet cool and dry.</td>
</tr>
<tr>
<td>Tinea manus</td>
<td>Dry, scaling hyperkeratosis of the palms; may be unilateral with accompanying bilateral tinea pedis; nails often involved.</td>
<td>KOH test, Culture</td>
<td>Same as for tinea pedis of the chronic dry, scaling type 1 (above).</td>
</tr>
<tr>
<td>Tinea barbae</td>
<td>Inflammation of bearded area of face and neck.</td>
<td>KOH test, Culture</td>
<td>Topical imidazoles, Griseofulvin, Moist compresses.</td>
</tr>
</tbody>
</table>

Once you've done the KOH, interpretation is critical. A simple rule of thumb is that dermatophyte infections will show branching, septate hyphae, whereas yeast infections will demonstrate both spores and "pseudohyphae". There's a visible distinction, but it takes a certain amount...
Scalp infections caused by the *Microsporum* species will fluoresce under the Wood's light, but *Trichophyton tonsurans* infections will not.

<table>
<thead>
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<th>Infection</th>
<th>Clinical appearance</th>
<th>Diagnosis</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Tinea corporis</td>
<td>Papulosquamous annular lesions that expand peripherally and tend to clear centrally</td>
<td>KOH test, Culture</td>
<td>Haloprogin or topical imidazoles for limited infection; Griseofulvin in extensive cases or with follicular involvement.</td>
</tr>
<tr>
<td>Tinea cruris</td>
<td>Inflammation of crural area and inner thighs; scrotal skin rarely affected; may occur with tinea pedis</td>
<td>KOH test, Culture</td>
<td>Haloprogin or topical imidazoles for limited infection; Tolnaftate after clearing; Aeration of involved area; Griseofulvin for chronic cases with extensive lesions or follicular involvement.</td>
</tr>
<tr>
<td>Candidiasis</td>
<td>Usually limited to intertriginous areas; often seen in patients with diabetes or on long-term and broad-spectrum antibiotics, systemic corticosteroids, cytotoxic agents, or immunosuppressive drugs</td>
<td>KOH test, Culture for <em>Candida albicans</em></td>
<td>Does not respond to griseofulvin; Moist compresses; In acute cases, topical steroids in combination with or followed by nystatin, amphotericin B, or imidazoles; Aeration of involved area; Avoid harsh soaps and other irritants; Oral nystatin to control gastrointestinal tract reservoir of candidiasis; Avoid reinfection by sexual partner.</td>
</tr>
</tbody>
</table>

**Source:** Prepared for Modern Medicine by Andrew H Rudolph, MD.

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**of practice to know what you're looking for.**

3 **When would you recommend using a Wood's light?**

A Wood's light is helpful in diagnosing scalp infections caused by a particular group of dermatophytes - the small-spore *Microsporum* species, such as *Microsporum audouini*. **
FAST TRACK

Cultures may be necessary in *Trichophyton tonsurans* scalp infections when it's impossible to find the black dots (hair stubs) in the areas of hair loss.

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**What to do about fungal infections of the feet, hands and scalp**

**Tinea pedis.** There are three subtypes of tinea pedis, or fungal infection of the feet, caused primarily by the organisms *Trichophyton rubrum*, *Trichophyton mentagrophytes*, and, occasionally, *Epidermophyton floccosum*.

- The dry, scaly moccasin type involves the soles and the sides of the feet and is sometimes hyperkeratotic.
- The interdigital type is characterised by scaling and itching in the toe-web areas, usually between the third and fourth or fourth and fifth toes.
- The vesicular type is marked by small blisters on the ball and arch of the foot.

Due to the moist, warm environment of the feet, tinea pedis is difficult to treat and control, particularly when the toenails are involved. The moccasin type, in particular, is liable to relapse. The interdigital type tends to be chronic and often compounded by secondary bacterial infection. Although the vesicular type is also complicated in some cases by superimposed bacterial infection, it is usually easier to clear.

With toenail involvement, the prognosis for complete clearing is poor. There is no good topical therapy for nail infections, and treatment with oral griseofulvin is prolonged. Furthermore, because griseofulvin is fungistatic rather than fungicidal, infections tend to recur. In some cases, avulsion, or removal of the nail plate, may be necessary.

**Tinea manus.** A dry, scaling infection of the palm, tinea manus is also difficult to treat and likely to recur. An interesting syndrome, called "two-foot, one-hand disease," is characterized by tinea manus on one hand and tinea pedis on both feet. Curiously, it can persist for years.

**Tinea capitis.** This fungal infection of the scalp, occurs primarily in children and can be either inflammatory or noninflammatory. The epidemic noninflammatory type may be caused by an anthropophilic

douini and *Microsporum canis*. *M canis*, which is carried by animal vectors, is frequently isolated in developed countries.

These organisms produce ectothrix infections, with spores found on the outside of each hair strand. They fluoresce an apple-green under the Wood’s light. However, in the presence of inflammation, the fluorescence may be lost.

On the other hand – and this is a very important distinction – scalp infections caused by *T tonsurans*, an endothrix infection, will not fluoresce under a Wood’s light. For this reason, the Wood’s light cannot be used alone to screen for the presence of fungi in the scalp.

I also find the Wood’s light helpful in tinea versicolor infections to determine the extent of skin involvement.

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**4 Are cultures ever advisable?**

Generally speaking, the information obtained by culturing allows you to be more specific in your treatment of the patient. Unfortunately, few doctors perform cultures for fungal infections.

I think there are certain situations in which a culture is not only desirable, but necessary. One situation may be a scalp infection caused by *T tonsurans*. In these infections, it may be impossible to find infected hairs (black dots) in the areas of hair loss. The KOH test then becomes impossible, and you'll need to rely on a culture to make the diagnosis.

Another situation that may call for a culture is the fungal infection that's been treated inappropriately with topical steroid creams or partially treated with over-the-counter antimycotic agents. Often, these agents suppress the infection just enough to render
I use the topical imidazole derivatives in the treatment of localised dermatophyte and yeast infections or, in some cases, as adjuncts to oral therapy.

What to do about fungal infections of the feet, hands and scalp continued

fungus, such as Microsporum audouini or T. tonsurans. It is characterised by patchy alopecia, broken hairs, mild scaling, and minimal inflammation. Inflammatory tinea capitis may be due to a geophilic fungus such as Microsporum gypseum, to a zoophilic fungus such as Microsporum canis or Trichophyton mentagrophytes, or to an anthropophilic fungus such as T. tonsurans. Patients experience hair loss, inflammation, and, in some cases, the development of large, painful kerions.

Identification of many fungal infections of the scalp can be made by a positive KOH examination. With a kerion, the KOH may be negative, and a Gram’s stain smear of the pus may be helpful in identifying the fungi. The Wood’s light may also be helpful in identifying the fluorescing Microsporum species.

In suspected T. tonsurans infections, a culture is recommended. Black dots (infected hair stubs) should be isolated. If this is not possible, material for culturing can be collected from the patient’s hairbrush, or scales can be scraped from the scalp with a scalpel blade, a sterile toothbrush, or a moist sterile swab.

Oral griseofulvin is indicated in the treatment of all types of tinea capitis. Although treatment must be individualised, griseofulvin (microsize) is usually administered to children in a dosage of 5 mg/kg/d. For adults, 0.5 grams bid is recommended. Ideally, treatment should continue for two weeks after signs and symptoms disappear and laboratory tests are negative.

Concomitant topical therapy with an antifungal lotion and daily shampoos is also helpful. Moist compresses are useful in inflammatory tinea capitis. In some patients, systemic steroids for one or two weeks may be necessary to control inflammation.

— Andrew H. Rudolph, MD

the KOH negative, but the infection may remain smouldering in the hair follicles.

Cultures are also helpful from a treatment standpoint. Suppose you have a KOH-confirmed dermatophyte infection on the skin surface. Upon culturing, you grow out M. canis. You can then alert your patient to the fact that the family pet may be responsible for the fungal infection.

5 Are there special culture media available?

The choice of culture medium depends on what organism you suspect and where the infection is located. For most hair and skin infections, Sabouraud’s dextrose agar, containing cycloheximide and chloramphenicol, is appropriate.

6 When, if ever, is a skin biopsy necessary?

A skin biopsy might be called for in a condition called “Majocchi’s granuloma”. This is usually seen in women who have shaved their legs and have accidentally inoculated the hair follicles of their legs with a fungus from their feet. A skin biopsy of the infected hair follicles may help to identify the infection.

Another situation is the dermatophyte infection that I call “tinea profunda”, in which there’s deep, granulomatous involvement of the skin and hair follicles.

Rx: topical versus oral therapy

7 When would you choose an imidazole derivative to treat a fungal infection?

There are three imidazole derivatives (along with other topical medications) available: clotrimazole, micona-
**TABLE 2**

Antifungal agents: which one for which infection?

<table>
<thead>
<tr>
<th>Generic</th>
<th>Trade name(s)</th>
<th>Vehicles available</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Topical</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Imidazole derivatives</td>
<td>Canesten</td>
<td>Cream or solution Vaginal cream or tablet</td>
<td>X</td>
</tr>
<tr>
<td>Miconazole nitrate</td>
<td>Daktarin</td>
<td>Cream, lotion, or powder Vaginal suppository Vaginal cream</td>
<td>X</td>
</tr>
<tr>
<td>Econazole nitrate</td>
<td>Pevaryl</td>
<td>Cream, powder, solution, vaginal cream, ovules</td>
<td>X</td>
</tr>
<tr>
<td>Isoconazole</td>
<td>Travogen</td>
<td>Cream</td>
<td>X</td>
</tr>
<tr>
<td>Tioconazole</td>
<td>Trosyd</td>
<td>Cream</td>
<td>X</td>
</tr>
<tr>
<td>Haloprogan</td>
<td>Mycanden</td>
<td>Cream or solution</td>
<td>X</td>
</tr>
<tr>
<td>Tolnaftate</td>
<td>Tinaderm</td>
<td>Cream, powder, or solution</td>
<td>X</td>
</tr>
<tr>
<td>Amphotericin B</td>
<td>Fungizone</td>
<td>Lozenges, oral suspension, tabs, ointment</td>
<td></td>
</tr>
<tr>
<td>Nystatin</td>
<td>Mycostatin</td>
<td>Cream, ointment, Vaginal tablet Vaginal cream Oral suspension</td>
<td></td>
</tr>
<tr>
<td>Selenium sulphide</td>
<td>Selsun</td>
<td>Lotion-shampoo</td>
<td>X</td>
</tr>
<tr>
<td>Sodium thiosulphate</td>
<td>Selsun</td>
<td>Lotion</td>
<td>X</td>
</tr>
<tr>
<td>Salicylic acid 3%, benzoic acid 6%, in zinc oxide*</td>
<td>Whitfield's</td>
<td>Ointment</td>
<td>X (tinea nigra)</td>
</tr>
<tr>
<td>Salicylic acid 10%, in petrolatum*</td>
<td>—</td>
<td>Ointment</td>
<td>X</td>
</tr>
<tr>
<td><strong>Systemic</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Griseofulvin</td>
<td>Grisovin, Fulcin 125, 500 Microcidal</td>
<td>Tabs</td>
<td></td>
</tr>
<tr>
<td>Ketoconazole</td>
<td>Nizoral</td>
<td>Tablet</td>
<td>X</td>
</tr>
<tr>
<td>Nystatin</td>
<td>Mycostatin</td>
<td>Tablet</td>
<td>X</td>
</tr>
</tbody>
</table>

*Keratolytic agent.

Source: Prepared for Modern Medicine by Andrew H. Rudolph, MD
Griseofulvin is indicated in the treatment of all forms of tinea capitis, because topical preparations can’t adequately penetrate into hair follicles.

Are fungal infections contagious?

Whether or not a fungal infection is contagious depends on the organism. There are three groups of fungi: geophilic (soil), zoophilic (animal), and anthropophilic (human). Microsporum gypseum originate in the soil, but it can be transmitted to humans by animals or fomites. Microsporum canis is usually transmitted by animals; rarely is it transmitted from one individual to another. However, family members in contact with the infected animal are at risk.

Scalp infections caused by Trichophyton tonsurans can be transmitted from person to person, as can those caused by Microsporum audouini which used to cause epidemics among school children. Although tinea capitis is thought of as a childhood infection, adult women are also susceptible to T. tonsurans infection.

In infections of the feet, susceptibility seems to vary with the amount of inoculum received and with the individual’s own resistance to the organism.

Finally, candidiasis can be transmitted from person to person, especially between sexual partners.

— Andrew H. Rudolph, MD

I use these agents in the topical treatment of localised dermatophyte and yeast infections. But they can also be used as adjuncts to oral therapy in patients with more generalised fungal infections of the skin, or for those patients with generalised infections who cannot take the systemic medications.

8 When is it necessary to use the oral agent griseofulvin (griseofulvin microsize; griseofulvin ultramicrosize)?

If the dermatophyte infection covers an extensive area of skin, or follicular involvement is great, I prescribe griseofulvin.

Griseofulvin is also indicated in the treatment of all forms of tinea capitis, where topical preparations are simply ineffective because of inadequate penetration into hair follicles.

I would probably also use griseofulvin in conjunction with an imidazole derivative to try to clear up a chronic tinea of the hands and feet.

However, griseofulvin is not a medication to be taken lightly. Some patients develop side effects, nausea being a common one. Some patients also suffer from intractable headaches. Griseofulvin is contraindicated in pregnant women and in patients with porphyria or hepatic disease.

9 When, if ever, do you use the old standby, selenium sulphide?

Selenium sulphide is certainly a satisfactory treatment for tinea versicolor, especially in those patients with extended involvement of the skin.

This lotion-shampoo can be lathered on the skin after bathing, allowed to dry for 30 minutes, then rinsed off. This regimen should be repeated at weekly intervals for two weeks, then gradually tapered off over a period of five or six months. Between treatments, Tinver lotion or an imidazole can be applied twice daily to all visible scaly areas.

Nowadays, I usually use selenium sulphide as an adjunct to the imidazoles in treating tinea versicolor. Used alone, the imidazole derivatives can be quite costly, especially if large areas of skin are involved, so selenium sulphide helps lower the cost of treatment.
10 Do you ever recommend that a patient use one of the over-the-counter preparations, such as tolnaftate or undecylenic acid?

Although these products may be used against dermatophyte infections, in my practice they've largely been supplanted by the more effective imidazoles. But they are still effective in some cases, and I don't object if a patient wants to use one.

11 Are there other older medications that are effective but have been overlooked?

Whitfield's ointment is a keratolytic fungicide, which can be used to treat localised – and particularly hyperkeratotic – fungal infections. In fact, in tinea nigra, a fungal infection of the palm's, Whitfield's ointment works quite well.

Also, before the imidazoles became available, we relied heavily on Tinver lotion to treat tinea versicolor.

12 What role do you think the new topical antifungal, ciclopirox olamine will play in therapy?

Reports from the foreign literature indicate that ciclopirox,
which is not an imidazole derivative, may be helpful in dermatophyte infections of the nails, in addition to those of the skin. However, its efficacy in the treatment of fungal infections of the nails remains to be determined.

13 How do you go about treating the superficial candidal infections?

Candidiasis is usually limited to the intertriginous areas, such as the groin, the axilla, and the inframammary area. It’s aggravated by a hot, humid environment, and it does not respond to griseofulvin.

Treatment really depends on the clinical situation. I often treat an acute intertriginous candidiasis in almost the same way as I’d treat an acute contact dermatitis: with moist compresses to dry out the weeping, oozing areas and a topical steroid preparation. But I also use a topical imidazole agent.

The new broad-spectrum oral imidazole derivative, ketoconazole (Nizoral), is also very effective in cutaneous candidal infections. But I would reserve it for severe cases. In less acute cases, don’t use a topical steroid; rely only on the anti-candidal agents.