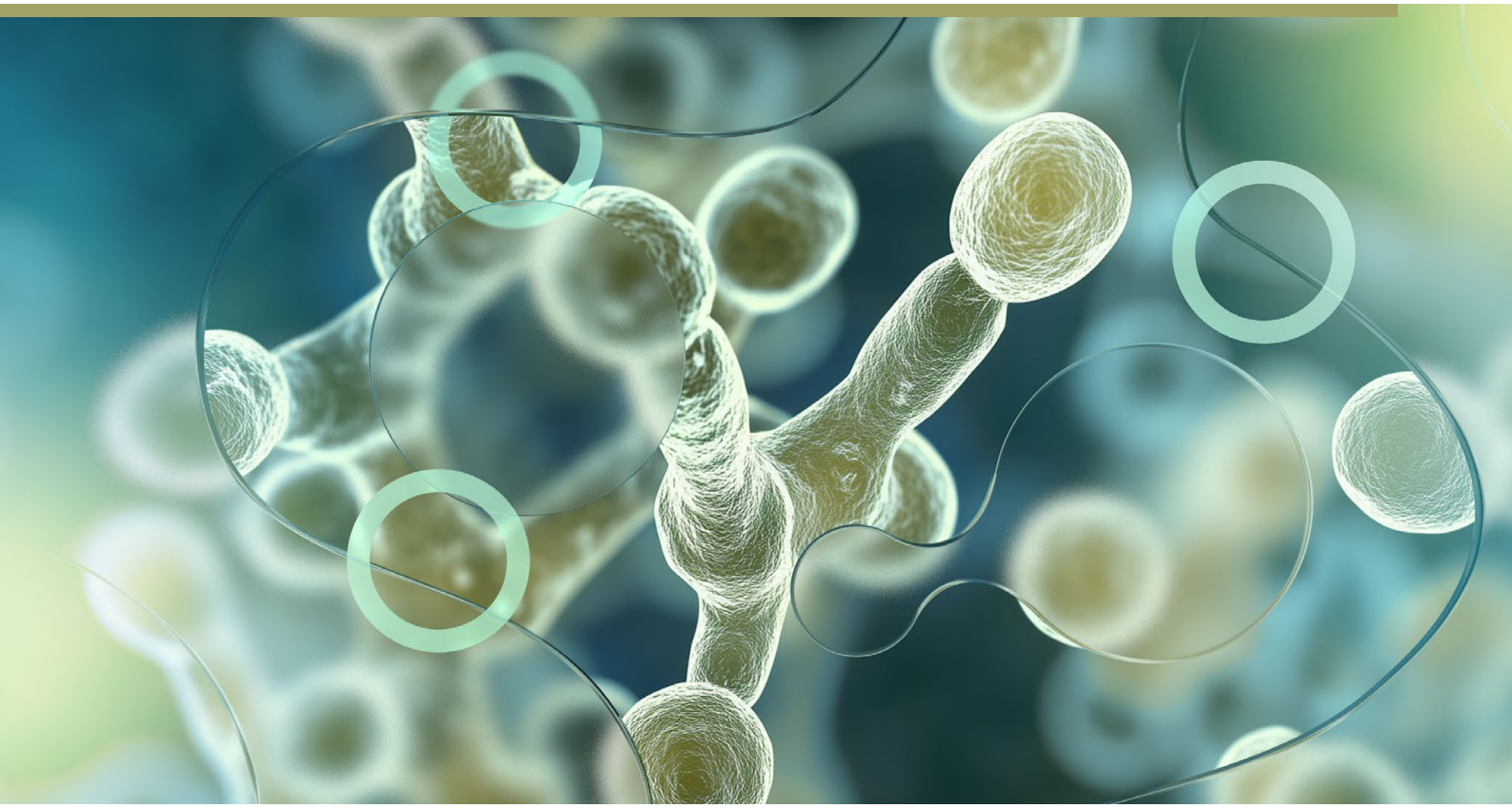

Management of fungal nail infections

Fungal nail infection (onychomycosis) is a common clinical problem, especially in older adults, and can significantly impact quality of life. Laboratory confirmation is recommended before initiating treatment. Both oral and topical antifungals are available for patients who wish to proceed with treatment; prescribing decisions are determined by severity of infection, co-morbidities, potential for medicines interactions and preference.

KEY PRACTICE POINTS

- Dermatophytes are fungi that degrade keratin, and are the most common cause of fungal nail infections
- Laboratory diagnosis of onychomycosis with microscopy and culture of nail clippings is recommended before starting oral or topical treatment. Microscopy results are usually available within a few days. However, culture can take up to four weeks to confirm the causative organism.
  - If antifungal treatment is started before testing, it may not be possible to later confirm mycological infection if symptoms do not improve
- Treatment may not be necessary for all patients and specific medicines may be inappropriate in some cases, e.g. patients with frailty, co-morbidities, taking multiple medicines or with limited mobility (to apply treatment to toenails)
- Antifungal treatment selection depends on the causative organism and patient factors:
  - Oral terbinafine is first-line treatment for dermatophyte onychomycosis
  - Oral itraconazole is preferred for onychomycosis caused by candida infection
  - Topical amorolfine (funded) or ciclopirox (not funded) may be suitable for patients with superficial infection or infection confined to the distal nail plate and for those unable to take oral antifungals
  - Terbinafine-resistant dermatophytes have recently been isolated in New Zealand, highlighting the importance of mycology culture prior to initiating treatment
- Incomplete resolution is a common occurrence. Check adherence to the treatment regimen and consider antifungal resistance. Consider switching to a different oral antifungal, combination oral and topical treatment or discuss with a dermatologist or clinical microbiologist.
- Ensure the patient has realistic expectations regarding long-term outcomes. Successful antifungal treatment can take years and nail appearance may never completely return to normal.

What's changed? This is a revision of a previously published article *Management of fungal nail infections* (BPJ 19, February 2009). What's new for this update:

- A general article revision based on updated evidence
- Expanded differential diagnosis
- Section included on antifungal-resistant dermatophytes
- Indications added for combination antifungal treatment
- Information added on onychomycosis prophylaxis in high-risk patients

Glossary of terms

The following terms relate to nail pathology:[1–3]

- Onychauxis – thickening of the nail plate
- Onychodystrophy – abnormal nail growth
- Onychogryphosis – hypertrophy and curving of the nail as it grows ("ram's horn nail")
- Onycholysis – distal detachment of the nail plate from the nail bed
- Onychomadesis – proximal detachment of nail plate from the nail bed leading to complete nail separation as the nail grows
- Onychomycosis – fungal nail infection
- Onychorrhexis – longitudinal striations
- Onychoschizia – brittle or splitting nails
- Paronychia – inflammation or infection of the nail fold
- Subungual hyperkeratosis – thickening of the stratum corneum under the nail plate
- Tinea unguium – onychomycosis caused by a dermatophyte fungus

For an illustration of nail anatomy, see Figure 1.

Fungal nail infection; not just a cosmetic concern

Fungal infection of the nail, or onychomycosis, is a common clinical problem in primary care. It affects approximately 4 – 6% of the global population, with prevalence increasing with age.[4, 5] It is estimated that at least one-fifth of people aged over 60 years, and more than half of people aged over 70 years, experience onychomycosis compared with fewer than 0.1% of primary school-aged children.[4, 5] This increased prevalence in older age groups is likely due to reduced nail growth and impaired peripheral circulation as part of the ageing process, as well as increased co-morbidities and potential for nail trauma.[3, 4] Common risk factors for onychomycosis include other household members with fungal infections, use of public changing rooms and showers at a gym or swimming pool, poor foot hygiene or nail grooming, tinea pedis (athlete's foot), hyperhidrosis (excessive sweating), nail trauma and occlusive footwear.[3] Clinical conditions such as psoriasis, diabetes and immunosuppression are also associated with the development of fungal nail infections.[3, 4]

Onychomycosis is not only a cosmetic issue; severe fungal nail infection may have a significant impact on a person's quality of life.[3, 6] Initial infection in a single nail can spread to unaffected nails (or other people) if left untreated and in some cases, permanent nail damage may occur.[7, 8] Some people may experience embarrassment, psychosocial distress and limit certain social interactions due to the appearance of their nails.[3] Significant changes in nail shape and hardness (or brittleness) seen in advanced infection can make nail grooming challenging and may lead to pain when wearing footwear or walking, reducing mobility.[3] Onychomycosis also increases the risk of local damage; associated tinea pedis can cause fissuring and subsequent bacterial infection (e.g. cellulitis) in people with diabetes and those who are immunosuppressed.[8, 9]

Dermatophytes are the most common cause of fungal nail infection

Onychomycosis is caused by dermatophytes (fungi that degrade keratin) in approximately 60 – 90% of infections; *Trichophyton rubrum* is the most frequently identified causative organism.[3, 8, 11] *T. interdigitale* and *Epidermophyton floccosum* have also been isolated in nail cultures in New Zealand; *T. indotineae*, which is often resistant to standard treatment, is now emerging (see: "Oral antifungal resistance is rising").[11] Yeasts, mainly *Candida albicans*, are the cause of 10 – 20% of onychomycosis cases and more commonly affect the fingernails.[3] Non-dermatophyte moulds (e.g. *Aspergillus, Fusarium*, *Scopulariopsis* and *Neocytalidium* species) account for approximately 10% of nail infections.[3] Polymicrobial infections have been reported, making treatment challenging and increasing risk of recurrence.[3]

Distal and lateral subungual onychomycosis is the most common morphology of fungal nail infection

Most cases of onychomycosis are characterised by onychauxis (thickening), onychoschizia (brittle nails), discolouration (usually yellow, white or brown) and onycholysis (separating of the nail from the nail bed).[2, 3] Toenails are more likely to be affected than fingernails.[3] See Figure 1 for a general overview of nail anatomy.

Onychomycosis can be classified into different morphological types based on the pattern of nail involvement:[2, 8, 9, 12, 13]

- **Distal and lateral subungual onychomycosis** is the most common classification and is usually caused by dermatophyte infection, e.g. *T. rubrum*. This begins in

the distal or lateral part of the nail plate and spreads proximally under the nail (Figure 2A).

- **Superficial white onychomycosis** is also caused by dermatophyte infection (usually *T. interdigitale*) and is more commonly seen in children than adults (Figure 2B). It appears as small, white, powdery patches on the surface of the nail.
- **Proximal onychomycosis** is a less common type of onychomycosis and usually present in patients who are immunosuppressed, e.g. human immunodeficiency virus (HIV) (Figure 2C). It begins as discolouration of the proximal end of the nail plate and advances distally as the nail grows.
- **Endonyx onychomycosis** is infection of the nail plate while the nail bed is unaffected. There is often lamellar splitting, milky-white discolouration and indentations, however, hyperkeratosis is not observed.
- **Dermatophytomas** (onychomas) are yellow or white fungal masses comprising of filaments and spores that form in the subungual space under the nail plate. These can appear as patches or longitudinal streaks and are difficult to distinguish from other onychomycosis subtypes. The use of dermatoscopy and optical coherence tomography (secondary care) can make identification easier.
- **Total dystrophic onychomycosis** is the complete destruction of the nail structure resulting from chronic infection. It can be challenging to treat, and the likelihood of nail restoration is often dependent on the extent of nail bed involvement.

Nail salons may increase risk of developing onychomycosis

Another potential risk factor for fungal nail infection is the use of nail salons. Inconsistent regulation of the nail salon industry across New Zealand and unhygienic practices may contribute to the spread of onychomycosis. A 2018 survey of local businesses by Wellington Regional Public Health found many nail and beauty salons employed staff without formal qualifications, had no written protocols for infection control or cleaning schedules and there was generally a low level of awareness regarding the risk of dermatophyte transmission and other infection control.[10] Therefore, ask patients who present with possible onychomycosis if they have used nail salons recently. In some cases, it may be appropriate to suggest a patient enquires about hygiene practices at a nail salon before attending, e.g. those at higher risk of onychomycosis.

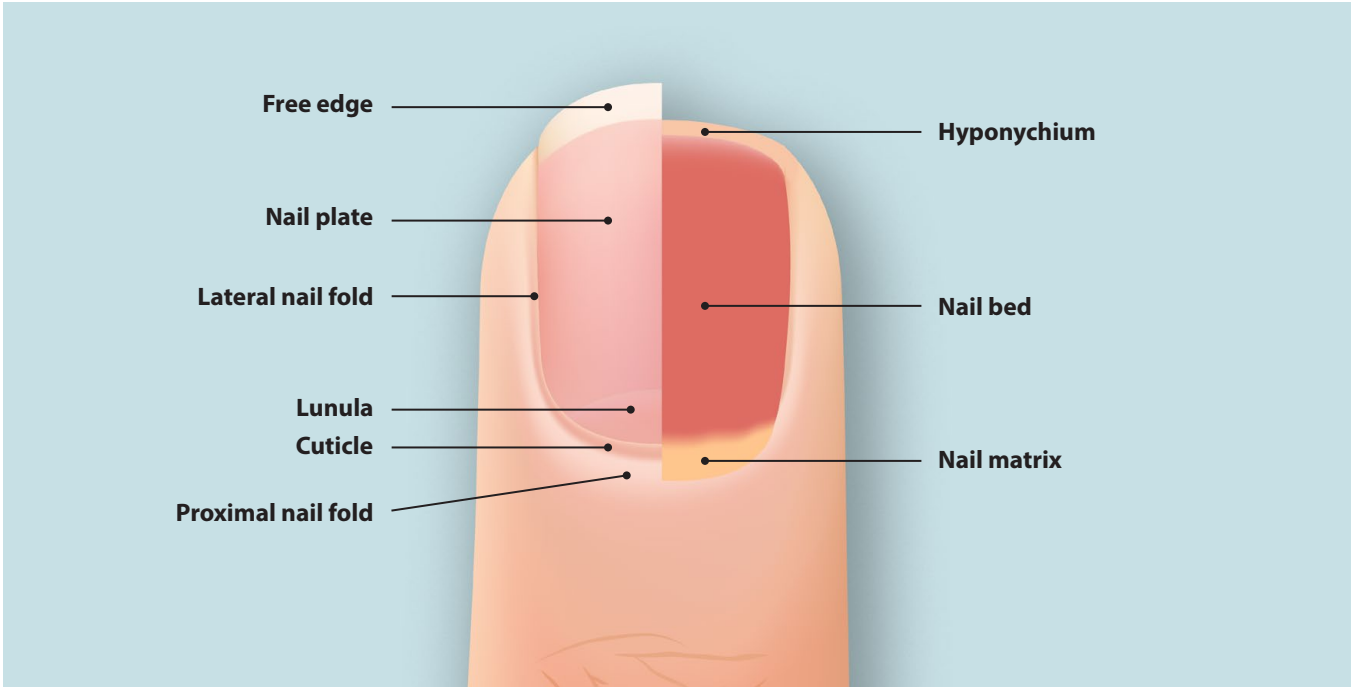

Figure 1. Nail anatomy.

- **Mixed pattern onychomycosis** involves features of more than one onychomycosis subtype, e.g. distal and lateral subungual and superficial white onychomycosis in a single nail
- **Candidal onychomycosis** typically occurs in the fingernails of people who frequently immerse their hands in water and is often associated with paronychia (Figure 2D)

Onychomycosis differential diagnoses

Many features of onychomycosis are shared by other nail conditions and can make diagnosis challenging in some patients. These include:[2, 9, 12, 14]

- Bacterial nail infection – green or black discoloration often caused by *Pseudomonas aeruginosa*
- Chronic nail trauma – incorrect footwear causing friction. Often only one nail is affected.
- Lichen planus – nail thinning with longitudinal ridges or grooves, typically involving most nails. There is often evidence of lichen planus at other sites.
- Psoriasis affecting the nail – pitting, onycholysis, discolouration (e.g. "oil drops" or "salmon patches"), thickening and irregular ridging. Fingernails are more likely to be affected than toenails. Check family history and look for psoriatic plaques on typical sites, e.g. scalp, ears, elbows and knees.
- Onychogryphosis – thickening, elongation and distortion of the nails, most often by the big toe. This is more common in older people.
- Periungual viral wart – can damage the nail plate (e.g. onycholysis, onychorrhexis [longitudinal striations]) depending on nodule location
- Squamous cell carcinoma – lateral onycholysis or nail destruction with a keratotic or red nodule, bleeding and pain. Clinical suspicion for malignancy should be increased if the lesion recurs following cryotherapy.
- Malignant melanoma – nail plate splitting, onychorrhexis, brown-black longitudinal band or red nodule, Hutchinson's sign (hyperpigmentation involving the nail fold or hyponychium)
- Nail dystrophy caused by systemic disease, e.g. yellow nail syndrome associated with bronchiectasis or lymphoedema

Dermatoscopy may be useful to distinguish onychomycosis from these conditions.

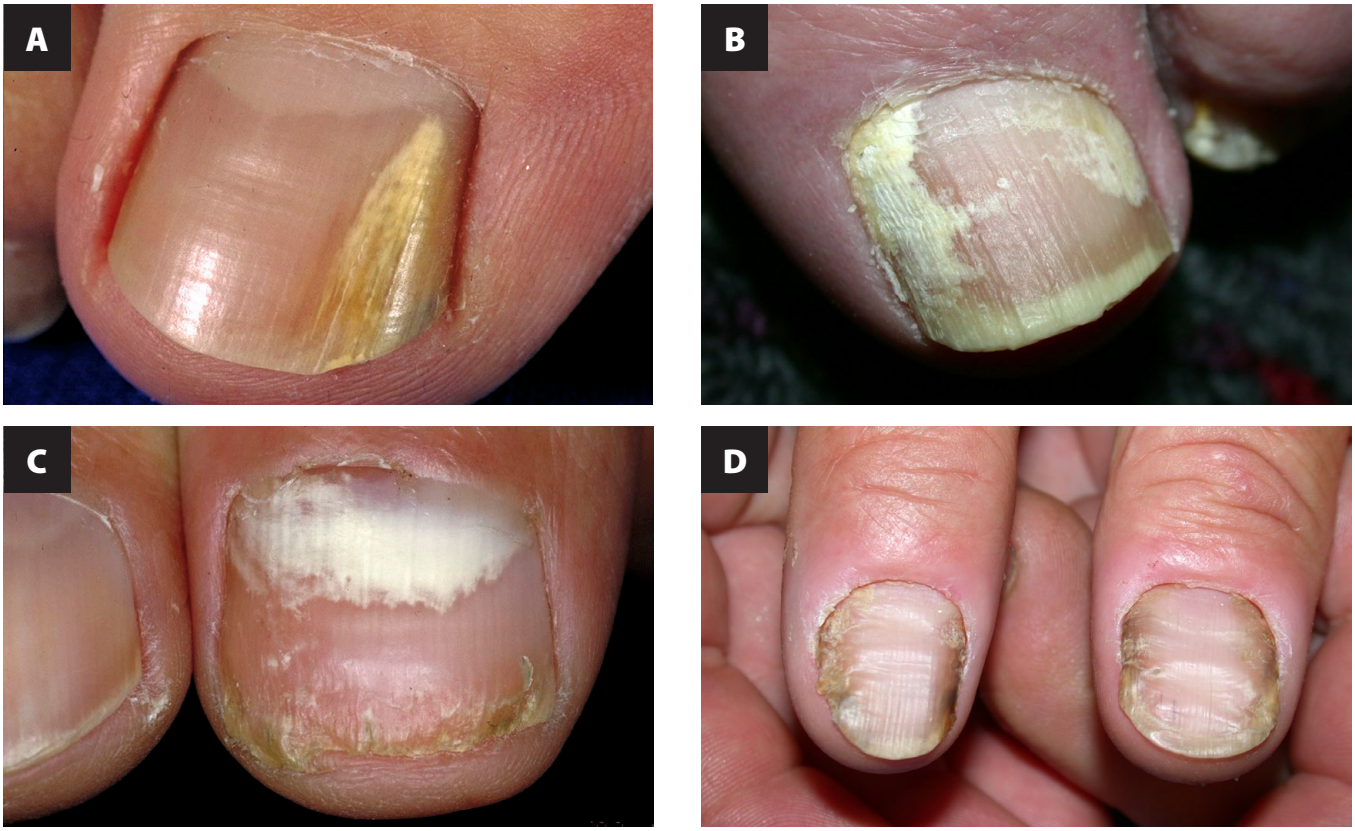

Figure 2. (A) Typical lateral onychomycosis (*T. rubrum*). **(B)** Extensive superficial white onychomycosis (*T. interdigitale*). **(C)** Proximal onychomycosis (*T. interdigitale*). **(D)** Typical onychomycosis and paronychia due to *C. albicans*. Images provided by DermNet NZ.

Laboratory confirmation is recommended before initiating treatment

It is recommended to confirm onychomycosis via laboratory diagnosis prior to initiating oral antifungal treatment.[3, 9, 12] Many other conditions have similar symptoms and successful treatment of onychomycosis may take months to years (see: "Onychomycosis differential diagnoses").[3] Therefore, ruling out a fungal cause would prevent unnecessary prescribing of antifungal medicines and associated adverse effects and medicines interactions.[2] This approach is encouraged (or discussion with a dermatologist), even if clinical suspicion of onychomycosis is high and the patient is experiencing severe symptoms (e.g. pain, limited mobility), as prompt initiation of treatment is seldom necessary. Prescribe short-term analgesia to patients with severe symptoms as required, while awaiting mycology confirmation.

Prior or empiric antifungal treatment may inhibit nail culture growth

Ask about any prescription or over-the-counter treatments the patient has already trialled. Antifungals may persist in the specimen even after treatment has ceased, inhibiting fungal growth and leading to false negative cultures and delaying confirmation.[3] A washout period of three to six months for both topical and oral antifungals is recommended before attempting mycological culture.[3] Include treatment history in the clinical details when requesting laboratory testing, if applicable.

Specimen collection

Collect nail clippings at presentation or refer the patient to a laboratory for specimen collection. To collect a specimen:[3, 14]

- Decontaminate the affected nail with soap and water or isopropyl alcohol
- Take nail clippings (using chiropody clippers) from the affected part of the nail and use a curette or scalpel blade to remove subungual debris
- Scrape the surface of the nail with a scalpel if superficial white onychomycosis is suspected

Provide the laboratory with as much of a sample as possible to increase the reliability of the culture findings.[14] The clippings and scrapings should be sent in a single container; laboratories in some regions recommend including the scalpel blade with the sample. Clipping or scraping the nail onto a contrasting background can aid visualisation of the amount of sample collected.[3] It may be necessary to delay specimen collection in some patients to allow the nail to grow longer.

For further information on the collection of specimens for investigation of fungal infections, see: **bpac.org.nz/BT/2011/March/fungal-infections.aspx**

For a video tutorial on specimen collection (seven minutes; skip ahead to one minute and 53 seconds for toenail specimen collection), click **here**.

Onychomycosis is diagnosed with microscopy and culture of nail clippings

Microscopy of a sample of the affected nail plate can identify fungal elements and mycological culture determines the causative organism.[3] Microscopy can be performed relatively rapidly, however, the accuracy of results is dependent on the expertise of the analyst, and it cannot precisely identify the causative organism or its viability.[3]

Mycological culture allows identification of the causative species, guiding treatment selection. However, dermatophyte growth rates are slow and results may not be available for three to four weeks.[2, 3] Growing fungal cultures is also challenging and false negative rates of up to 40% have been reported.[3] Poor specimen collection (e.g. insufficient sample, sample taken from an area without infection, contaminated sample) or prior antifungal treatment further decreases the likelihood of successful culture.[3]

Due to these factors, a specimen with negative microscopy may not be cultured if reliable fluorescent microscopy techniques are used initially. Laboratories in some regions may also not routinely carry out culture unless there is a suspicion of non-dermatophyte moulds or a history of unsuccessful oral antifungal treatment.[15]

Best practice tip: Collect a new specimen and repeat culture if the first sample is negative but there is still a high clinical suspicion for onychomycosis.[14]

Dermatologist opinion may be available in some regions if diagnosis remains uncertain

Patients with fungal nail infections will not often meet the threshold for a referral in person to a dermatologist, however, in some regions a dermatology opinion is available via e-referral (teledermatology). To be able to provide useful advice, the patient referral/clinical enquiry should include:

- ☐ Medical history including skin conditions, previous trauma and current medicines
- ☐ Clinical findings on general skin examination and examination of all fingernails and toenails: look for evidence of dermatophyte infection (soles, between toes, groin) or skin disease (particularly psoriasis, lichen planus and dermatitis affecting the digits)
- ☐ In focus and properly exposed images taken with an up to date high resolution camera, e.g. digital camera, mobile phone or tablet. The images should be suitable for email, e.g. medium compression (file size).
- ☐ Image(s) showing all the toenails or fingernails (even those unaffected)

- ☐ Close-up images of the nail of concern from above, side-on and end-on. Include views extending from the distal phalanx to the distal end of the nail plate.
- ☐ Ideally, dermatoscopy views of the entire nail unit (proximal nail fold to distal end of nail plate) as well as an end-on view
- ☐ Results of fungal microscopy and culture for the nail of concern
- ☐ Any treatments used and their duration

Check HealthPathways to see if this service is available in your region.

Treatment options for onychomycosis

The goal of treatment is to eliminate the causative organism and restore normal nail appearance, however, specific treatment options may not always be necessary or appropriate, e.g. patients with frailty, multiple co-morbidities, limited mobility or taking multiple medicines.[3, 7] A shared decision-making approach should be taken regarding proceeding with treatment, after the patient has been informed of the risks and benefits.[12]

Discuss the following points with the patient:[3, 5, 12, 16]

- Nails may not completely return to normal appearance after antifungal treatment due to destruction caused by the infection or pre-existing damage to the nail. N.B. Nail dystrophy can be due to trauma, inflammatory skin disease or an expansile lesion interrupting nail matrix function.
- Time to complete resolution differs between treatment options; potentially three to nine months with oral medicines compared with up to two years when applying topical antifungals to toenails
- Oral antifungal treatment success is highly variable with a clinical cure rate (i.e. no visible evidence of fungal infection) of 14% to 76% after 12 weeks, depending on the patient's age and co-morbidities, the chosen antifungal and isolate resistance
- There are potential adverse effects and medicines interactions with oral antifungals (use the **NZF interactions checker**)
- Topical treatment is generally less effective than oral treatment, especially if the infection is severe
- Regular nail "grooming" (e.g. debridement, filing, degreasing, and a certain level of mobility and dexterity) are required for topical application. This may be easier for older, frail patients if they have a support person.
- Topical medicines require perseverance and determination to continue treatment
- Relapse or recurrence may occur
- Potential for cutaneous spread leading to complications in patients with diabetes, immunodeficiency or peripheral vascular disease, e.g. tinea pedis causing dermal fissures increasing the risk of bacterial infection

Best practice tip: Assess for and treat co-existing tinea pedis. Concomitant tinea pedis is commonly found in people with onychomycosis and can act as a fungal reservoir increasing the risk of recurrence.[5, 8] Prescribe a standard topical antifungal alongside topical onychomycosis treatment if tinea pedis is identified, e.g. miconazole cream.[5] This is usually unnecessary when using oral antifungals.

Oral antifungal treatment is more effective

Oral antifungal treatment (terbinafine, itraconazole) is typically prescribed in preference to topical treatment (amorolfine, ciclopirox) in most clinical situations as it is more effective, and treatment duration is shorter.[12] However, oral treatment may not be necessary in patients with superficial white onychomycosis or in some cases of minor distal onychomycosis, and depending on the medicine, should be avoided in those with severe renal impairment, hepatic impairment or heart failure (see below).[12, 17] Oral antifungals are less effective in older patients due to differences in drug metabolism, immune response and slow nail growth.[5, 18]

Terbinafine is first line for dermatophyte infection

Terbinafine is the first-line treatment for patients with confirmed dermatophyte onychomycosis (Table 1).[9] Terbinafine may remain in the nail tissue for up to six months after treatment discontinuation,[9] potentially prolonging its fungicidal effect after treatment has ceased.

Gastrointestinal effects (e.g. nausea, abdominal discomfort, diarrhoea, dyspepsia and taste disturbance), skin reactions (e.g. morbilliform rash, urticaria) and headaches are the most common adverse effects associated with terbinafine.[17, 19] Rarely, severe skin reactions (e.g. Stevens-Johnson syndrome, toxic epidermal necrolysis, drug hypersensitivity syndrome, angioneurotic oedema) and haematological disorders (e.g. agranulocytosis, neutropenia, pancytopenia, thrombocytopenia) have occurred with terbinafine treatment.[17] Psoriasis may also be aggravated, if present.[14]

Avoid terbinafine in patients with severe renal impairment (i.e. CrCl < 20 mL/min) and hepatic impairment.[17] Halving the dose in patients with less severe renal impairment (i.e. CrCl < 50 mL/min) should be considered if there is no alternative treatment available.[17] Patients taking terbinafine must also be advised to promptly report any symptoms that may suggest hepatotoxicity such as anorexia, nausea, vomiting or fatigue.[17]

Table 1. Oral antifungal treatment options.[14, 17, 19]

Medicine	Indications	Dose (for paediatric dosing, see NZFC)	Baseline testing and monitoring
Terbinafine	Dermatophyte onychomycosis	250 mg, once daily, for six weeks (fingernails) or 12 weeks (toenails) Longer course may be required if fungal toenail infection has not shown improvement in 12 weeks	Request baseline full blood count and liver function tests (LFTs) Re-check four to six weeks after treatment initiation – discontinue treatment if abnormal results
Itraconazole*	Candidal onychomycosis	200 mg, twice daily, for seven consecutive days of the month, for two months (fingernails) or three months (toenails†). Treatment-free interval is 21 days. Alternatively, 200 mg, once daily, for three months**	Measure LFTs at baseline Ongoing liver function monitoring is recommended for courses lasting longer than one month, or if patient has a history of hepatotoxicity or is taking hepatotoxic medicines

* Take with food or acidic beverage to improve absorption

† Candidal onychomycosis is less common in toenails

** There is no evidence that continuous or intermittent regimens produce significantly different cure rates or adverse effects

Itraconazole is preferred for treating candidal onychomycosis due to its broad antifungal activity (Table 1).[9] It is also an alternative treatment option for patients with dermatophyte onychomycosis, however, it is less effective than terbinafine for this and medicines interactions may limit its use.[9] A 2017 Cochrane review concluded that terbinafine is "probably" more effective than itraconazole with a similar rate of adverse effects based on moderate-quality evidence.[20] Itraconazole can remain in nail tissue for six to nine months after treatment cessation.[9]

Adverse effects associated with itraconazole include gastrointestinal effects, skin reactions (similar to terbinafine; see above), upper respiratory infections and reversible increases in hepatic enzymes.[3, 17] Uncommon adverse effects include hepatotoxicity, severe skin conditions (Stevens-Johnson syndrome, toxic epidermal necrolysis, acute generalised exanthematous pustulosis, erythema multiforme), nervous system disorders (peripheral neuropathy, headache, dizziness) and congestive heart failure.[17] Pulse treatment with itraconazole may reduce the likelihood of adverse effects.[9]

Avoid itraconazole in patients with a history of heart failure (or at risk of developing heart failure) and use with caution in those with hepatic impairment or elevated liver enzymes.[17] Advise patients to seek medical attention if they develop symptoms that may suggest hepatotoxicity or heart failure while taking itraconazole.[17]

Both terbinafine, a CYP2D6 inhibitor, and itraconazole, a potent CYP3A4 inhibitor, are associated with medicines interactions, e.g. antiarrhythmics, benzodiazepines, calcium channel blockers, statins, tricyclic antidepressants, warfarin.[5, 17, 19] For further information on medicines interactions, see the NZF Interactions Checker available **here**.

Oral antifungal resistance is rising

Cases of antifungal-resistant dermatophytes are increasingly emerging overseas and have now been reported in New Zealand.[11, 21] *T. indotineae*, previously considered a subtype of *T. mentagrophytes* and closely related to *T. interdigitale*, is of particular concern due to terbinafine resistance.[22] In a New Zealand study of dermatophyte infections from 2017 – 2024, it was found that only 61% of *T. indotineae* isolates were susceptible to terbinafine.[11] Most *T. indotineae* isolates were sensitive to itraconazole,[11] but reduced sensitivity to itraconazole regimens is being reported internationally.[22]

Onychomycosis caused by *T. indotineae* is uncommon in the literature.[23] In the New Zealand dermatophyte study, *T. indotineae* was the causative organism in 9% of total dermatophyte cases reported (mainly tinea corporis and tinea cruris, i.e. body and groin).[11] However, of the 199 fungal nail infections reported, only 2% were attributed to *T. indotineae*.[11]

The detection of *T. indotineae* in New Zealand highlights the importance of mycology testing to confirm the presence of fungi (and may prompt antifungal susceptibility testing).

Topical treatment may be suitable for superficial onychomycosis

Topical treatments can be considered when onychomycosis does not involve the nail matrix (i.e. superficial white onychomycosis, early distal or lateral subungual onychomycosis) and only affects one or two nails.[12] They can

also be used when a patient is unable to take oral antifungals due to contraindications or medicine interactions, or unwilling to due to the potential for adverse effects.[12]

Topical preparations available in New Zealand are classified as Pharmacy-Only medicines and include (see: "Pharmacies can supply topical antifungals over the counter"):[17, 24]

- **Amorolfine 5%** (MycoNail [funded on prescription, Pharmacy-Only], Loceryl [not funded, Pharmacy-Only]) is applied to the affected nail once or twice weekly until the infection is resolved, usually six months for fingernails and 9 – 12 months (or longer) for toenails.[17] Artificial nails and nail varnish should not be used during the treatment period.[17]
- **Ciclopirox 8%** (Rejuvenail [not funded, Pharmacy-Only], Batrafen [Section 29]) is applied to the affected nail every second day for the first month, then application is reduced to twice weekly for the following month, and then once weekly for up to six months or longer.[17]

N.B. Application instructions differ between the specific products. Advise patients to carefully read the product information leaflet before first application.

Local adverse effects are typically mild with topical treatments and generally occur when the product is applied to skin instead of the nail surface, e.g. irritation, erythema, pruritus, transient burning sensation and nail bleeding may occur after application.[3, 17] Treatment should be stopped if these features become severe.[17]

Evidence suggests topical treatments are generally less effective than oral antifungals.[12] Penetration of the medicine is limited by the nail plate's compact keratin network and hydrophilicity; medicine concentrations on the surface of the nail are typically substantially higher than on the inner surface.[8, 9] Insufficient adherence may further reduce the likelihood of a cure as regular application over a long duration is required. Switch patients to oral treatment if no contraindications and there has been no visible improvement after six months of treatment.[12]

Combination treatment may be required for those at highest risk of complications

Prescribing both oral and topical medicines together is not routinely recommended,[3] and there can be additional costs for patients.* The use of two medicines may improve cure rates through synergistic effects and broader antifungal activity, however, the evidence of a greater effect is conflicting.[25] The combination treatment strategy depends on the clinical situation:[7]

- Patients who do not experience resolution with previous oral monotherapy should complete another oral antifungal course before using a topical antifungal (*sequential treatment*)
- Those with poor prognostic factors (e.g. diabetes, immunodeficiency, peripheral vascular disease) should be prescribed both an oral and topical medicine at the same time (*parallel treatment*)
- Combination treatment may also be considered when antifungal-resistant dermatophyte strains or moulds are identified as the causative organism, to increase the likelihood of treatment success.[21] Discussion with a clinical microbiologist is recommended prior to initiating combination treatment in this situation.

* Amorolfine is not funded on prescription when used in combination

Pharmacies can supply topical antifungals over the counter

A pharmacy may be the first point of contact for patients with fungal nail infections; topical antifungal treatments can be supplied over the counter. Pharmacists have a significant role explaining dosing and application instructions, the importance of treatment adherence for successful resolution and strategies to reduce recurrence for both prescription and over-the-counter medicines.[16]

Topical treatments can be recommended for patients with mild infection, when only one or two nails are affected, or in cases of superficial white onychomycosis.[8] Advise that use of topical antifungals may delay diagnosis if treatment is unsuccessful (as typically a washout period for topical antifungals of at least one month is required before laboratory confirmation can be reliable – or longer for oral antifungal treatment).

Patients with more advanced or recurrent infection, relevant co-morbidities (e.g. diabetes) and those in whom diagnosis is unclear or there has been an insufficient response to treatment should be referred to a general practitioner for assessment and discussion about the suitability of oral treatment.[16]

Monitor treatment response as nail grows

Ideally review patients with fungal nail infections regularly (e.g. every three months). Treatment response can be assessed by regularly photographing the nail or making a groove with a scalpel at the proximal end of the infected area.[14] If treatment is effective, the nail plate proximal to the groove should remain unaffected and nail appearance should improve as the nail grows out.[14] It can take three to six months for fingernails and up to 18 months for toenails to return to normal.[12] Some patients may be able to self-monitor their treatment response. A nail file can be used to redefine the groove over time.

There is no clear guidance on when to stop antifungal treatment, therefore, it is based on clinical judgement.[26] Prescribing a repeat antifungal course is appropriate in most cases if there is some evidence of the infection clearing. Treatment can be stopped once you are satisfied the fungal infection is not spreading proximally past the marked groove. Continued improvement is also possible after treatment ceases but patients should be aware that return to a completely normal nail appearance is not always achievable.[2, 12]

Address insufficient treatment response

Antifungal treatment courses often need to be repeated.[8] However, if there has been no evidence of improvement after approximately three months, check treatment adherence and application technique (for topical antifungals) before reconfirming mycology. Consider a higher dose for a longer duration (e.g. terbinafine 500 mg per day for 24 weeks),[27] a different medicine choice, a combination of oral and topical treatment or discuss management with a dermatologist or clinical microbiologist.

Nail removal, with or without ablation of the nail bed, is not recommended for the treatment of onychomycosis. There is limited evidence to allow comparison of conventional pharmacological treatment with novel device-based options, e.g. laser or photodynamic treatment,[3] and not all regions have access to these treatment options.

Ongoing prophylaxis to reduce recurrence

Weekly or twice-weekly prophylactic application of a topical antifungal after successful treatment has been achieved can be beneficial for reducing the chances of onychomycosis recurrence in high-risk patients.[3, 14] This may need to continue indefinitely as the optimal duration of prophylaxis has not been determined.[3, 14]

Provide lifestyle advice to reduce recurrence

Up to one-quarter of patients treated for onychomycosis experience recurrence of infection.[3] This may occur via relapse, where the treatment is stopped early, or reinfection, where the nail is recolonised after successful treatment.[3] Risk factors for recurrence include genetic predisposition, concomitant clinical conditions (e.g. diabetes, peripheral vascular disease) and immunosuppression.

Footcare advice for patients with recurrent nail infection:[3, 5]

- Keep feet cool and dry by wearing cotton socks and footwear made from breathable materials
- Keep nails trimmed and clean, and file down hypertrophic nails; referral to a podiatrist may be appropriate for some patients
- Regularly change socks and treat infected footwear (e.g. antifungal powders or sprays), if discarding them is not an option
- Recognise and treat tinea pedis in household members
- Wear footwear in communal showers, e.g. at public swimming pools
- Wear well-fitting footwear and avoid high heels and narrow toed shoes to prevent nail trauma
- Use commercial nail salons with caution (or avoid)

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