

# Fungal skin infections

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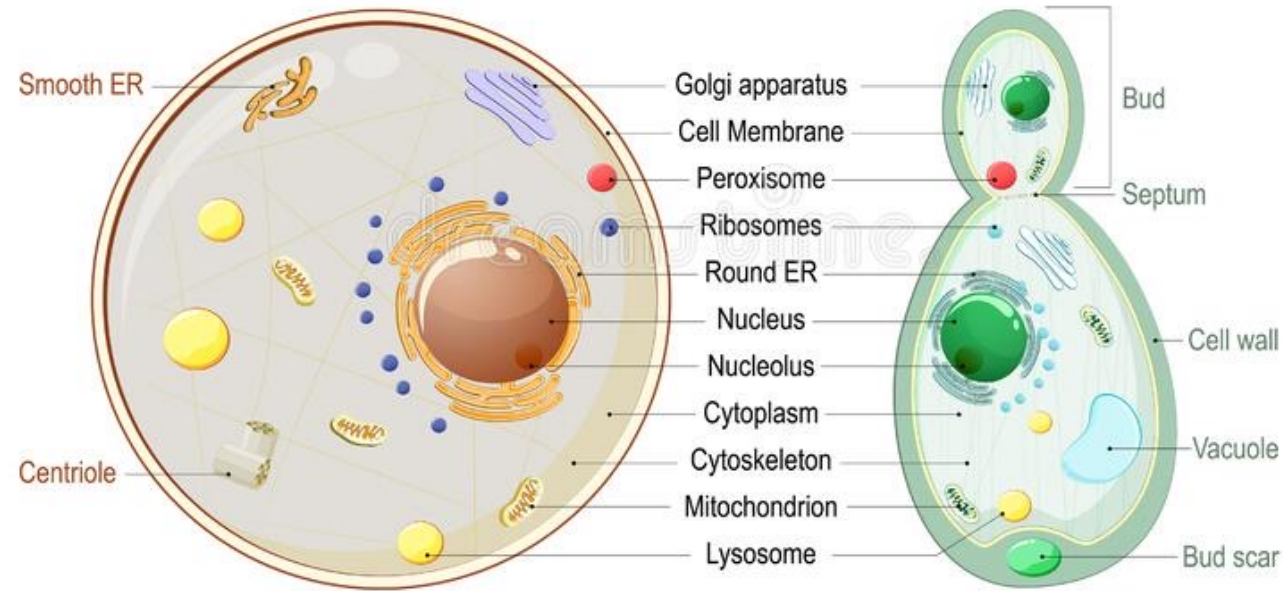
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# Fungi

Animal cell

Fungal cell



# Fungi

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- Can be divided based on:
  - Mode of nutrient acquisition (saprophytes, parasites, symbionts)
  - Type of occupied niche (geophilic, antropophilic, zoophilic)
  - Method of reproduction (sexual, asexual)

# Pathogens causing fungal skin infections

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- **Dermatophytes**
  - *Trichophyton*
  - *Epidermophyton*
  - *Microsporum*
- **Yeasts:**
  - *Candida*
  - *Malassezia*
- **Others (*Aspergillus*, *Blastomyces*, *Cryptococcus*, *Histoplasma*...)**

# Fungal skin infections

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- Glabrous skin
  - Scalp
  - Nails
  - Mucous membranes
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- Superficial (tinea, candidiasis, tinea versicolor)
  - Subcutaneous (sporotrichosis, chromoblastomycosis)
  - Deep (cryptococcosis)

# General predisposing factors

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- Cancer
- Diabetes mellitus
- Transplant
- Frequent antibiotic therapy, chronic steroid therapy
- Parenteral nutrition
- Cachexia
- Immunodeficiency (acquired/congenital)
- Occlusion (rubber shoes, nonabsorbant soaks, synthetic fibers)

# Diagnostics

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- Microscopy
  - Culture
  - Long-wavelength ultraviolet radiation (Wood lamp)
  - Molecular biology
- } Skin/hair/nail tissue

# Specimen collection

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- Scrapings of scale
- Skin strips stuck on a glass slide
- Hair pulled out from the roots
- Brushings of scaling in the scalp
- Nail clippings or skin scraped from under a nail
- Skin biopsy
- Mucosal swab in a special transport medium.



# Direct microscopy

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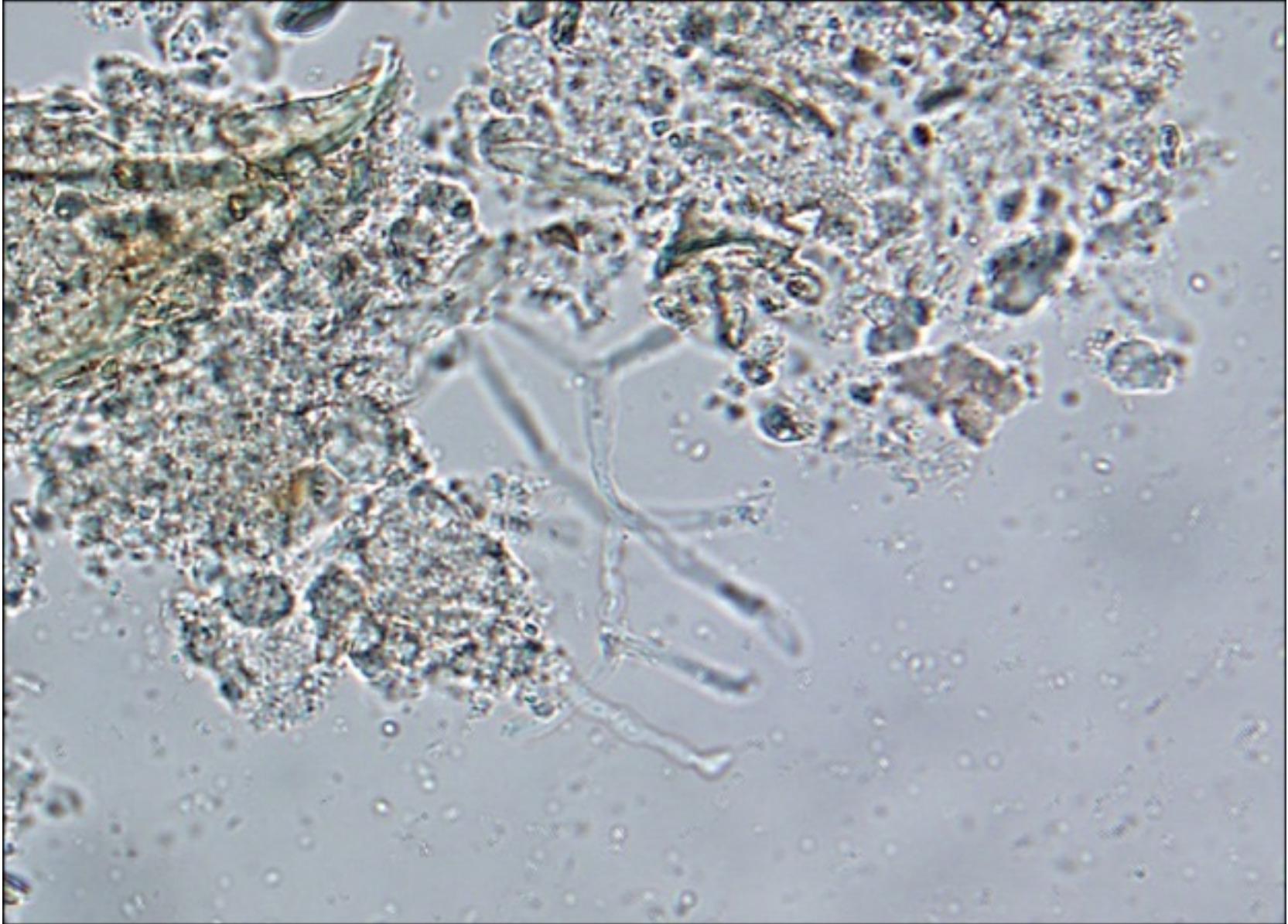
- Substrate – skin scrapings/nail clippings
- Potassium hydroxide (KOH) preparation, fluorescent staining, histopathology with special stains (e.g. PAS)

# Direct microscopy

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- Dermatophytes – fungal hyphae making up a mycelium, arthrospores (broken-off spores), arthroconidia (specialised external spores), spores inside a hair (endothrix) or outside a hair (ectothrix).
- Yeasts – yeast cells which may be dividing by budding, pseudohyphae (branched filaments similar to those of a dermatophyte) forming a pseudomycelium.

**DIRECT MICROSCOPY MAY BE NEGATIVE, ESPECIALLY IN INFLAMED TISSUES – CULTURE IS ALWAYS MANDATORY**



# Culture

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- On a medium (usually Sabourad's) for several weeks, temp. 25-30°C
- Harmless microorganisms can be cultured, especially in patients with other underlying skin conditions
- Negative results: condition not associated with fungal infection, improper specimen collection, use of antifungal treatment before the procedure, etc.



# Molecular studies

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- Mostly PCR reactions targeting selected genomic sequences of fungi
- Require genomic DNA isolation and purification
- Pros: quick and specific
- Cons: limited availability, expensive

# Tinea (dermatophyte infections)

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- Skin infection caused by dermatophytes (organisms favoring keratinized structures)
- Named after the affected body part
  - Tinea barbae (beard)
  - Tinea capitis (head)
  - Tinea corporis (body)
  - Tinea cruris (groin)
  - Tinea faciei (face)
  - Tinea manuum (hand)
  - Tinea pedis (foot)
  - Tinea unguium (nail)

# Tinea (dermatophyte infections)

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**TRICHOPHYTON** (skin, nails, hair)

**MICROSPORUM** (skin, hair)

**EPIDERMOPHYTON** (skin, nails, never invade hair)



# Dermatophyte reservoirs

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- Antropophylic (interpersonal transmission) – *Trichophyton rubrum*, *T. mentagrophytes*
- Zoophilic (animal to person) – *Microsporum canis*
- Geophilic (environmental) - *Microsporum*

# Tinea pedis

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- The most common type of dermatophyte infection
- Prevalent in hot, tropical, urban environments
- Risk factors: males, adolescents/young adults, occlusive footwear, hyperhidrosis, immunodeficiency
- Most cases are due to *T. rubrum*, *T. mentagrophytes* and *E. floccosum*

# Tinea pedis

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- Can be asymmetrical or unilateral
- Three main clinical presentations:
  - Interdigital itchy erosions and/or scaling (particularly between 4th and 5th fingers)
  - Scale covering the sole and sides of the feet (hyperkeratotic/moccasin type, usually caused by *T. rubrum*)
  - Small to medium-sized blisters, usually affecting the inner aspect of the foot (vesiculobullous type)
- Ddx: foot eczema, psoriasis, plantar pustulosis, plantar keratoderma





# Dermatophyte id reaction

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- Allergic rash (eczematous dermatitis) caused by dermatophytosis at a distant site (usually tinea pedis)
- Papules, vesicles or blisters associated with itch
- Lesions can be present on the face, trunk and/or limbs
- Requires both the treatment of underlying fungal infection and topical anti-inflammatory treatment



# Tinea manuum

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- Frequently coexists with tinea pedis (but it is far less common than the latter)
- Risk factors: hyperhidrosis, hand eczema
- Most cases are due to *T. rubrum*



# Tinea manuum

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- Usually unilateral or asymmetrical
- Clinical presentation: usually a slowly extending area of peeling, dryness and mild itching on the palm of one hand (hyperkeratotic tinea)
- May also present as blistering rash on the edges of the fingers or palm with a peeling edge
- Ddx: hand eczema, psoriasis, palmar pustulosis, palmar keratoderma



# Tinea corporis

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- Dermatophytosis of any part of the body excluding the hands and feet, scalp, face and beard, groin, and nails
- Commonly referred to as 'ringworm' due to its characteristic ring-shaped lesions
- Risk factors: previous or concurrent tinea infection, diabetes, immunodeficiency, hyperhidrosis, xerosis, crowding, keeping house pets, occlusive clothing
- Most cases are due to Trichophyton and Microsporum

# Tinea corporis

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- Initially presents as a solitary circular red patch with a raised scaly leading edge
- The lesion spreads out from the centre forming a ring-shape with central hypopigmentation and a peripheral scaly red rim
- The border can be papular or pustular
- Itch is common
- Multiple lesions may coalesce to form a polycyclic pattern

# Tinea corporis variants

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- Kerion — an intense pustular inflammatory reaction due to zoophilic fungi
- Tinea gladiatorum — participants in contact sports, skin-to-skin contact, usually caused by *T. tonsurans*
- Tinea imbricata — extensive concentric rings forming polycyclic plaques with thick scale due to *T. concentricum*
- Tinea incognito — lacks the typical features of tinea corporis due to suppression of the inflammatory reaction following anti-inflammatory treatment





# Tinea faciei

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- Clinical presentation identical to tinea corporis
- Uncommon and therefore frequently misdiagnosed
- Use of anti-inflammatory treatment can entail atypical clinical presentation (tinea incognito)





# Tinea cruris

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- Men>>women
- Unilateral or asymmetrical
- Lesions present on the upper thigh
- Pustules may be seen within the lesions
- Causative organism: *E. floccosum*, *T. rubrum*, *T. interdigitale*



# Tinea capitis

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- Typically seen in preadolescent children (3-7 years) or adults who are immunocompromised
- Most cases are due to *M. canis* and *T. tonsurans*
- Wood lamp examination is positive in the case of ectothrix infection (Microsporum), but not endothrix (Trichophyton)

# Tinea capitis

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- Partial hair loss and inflammatory lesions
- Clinical features vary according to the species of dermatophyte, type of hair invasion, and the extent of the inflammatory host response
- Non-inflammatory and inflammatory variants

# Tinea capitis

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- Non-inflammatory variant:
  - Grey patch: fine scaling of the scalp and patches of alopecia, which appear grey due to spores coating the affected hairs, variable erythema
  - Black dot: fine scaling with patches of alopecia, which appear speckled with black dots (broken hair shafts secondary to endothrix infection)
  - Diffuse scale: resembles generalised dandruff; alopecia subtle or absent.

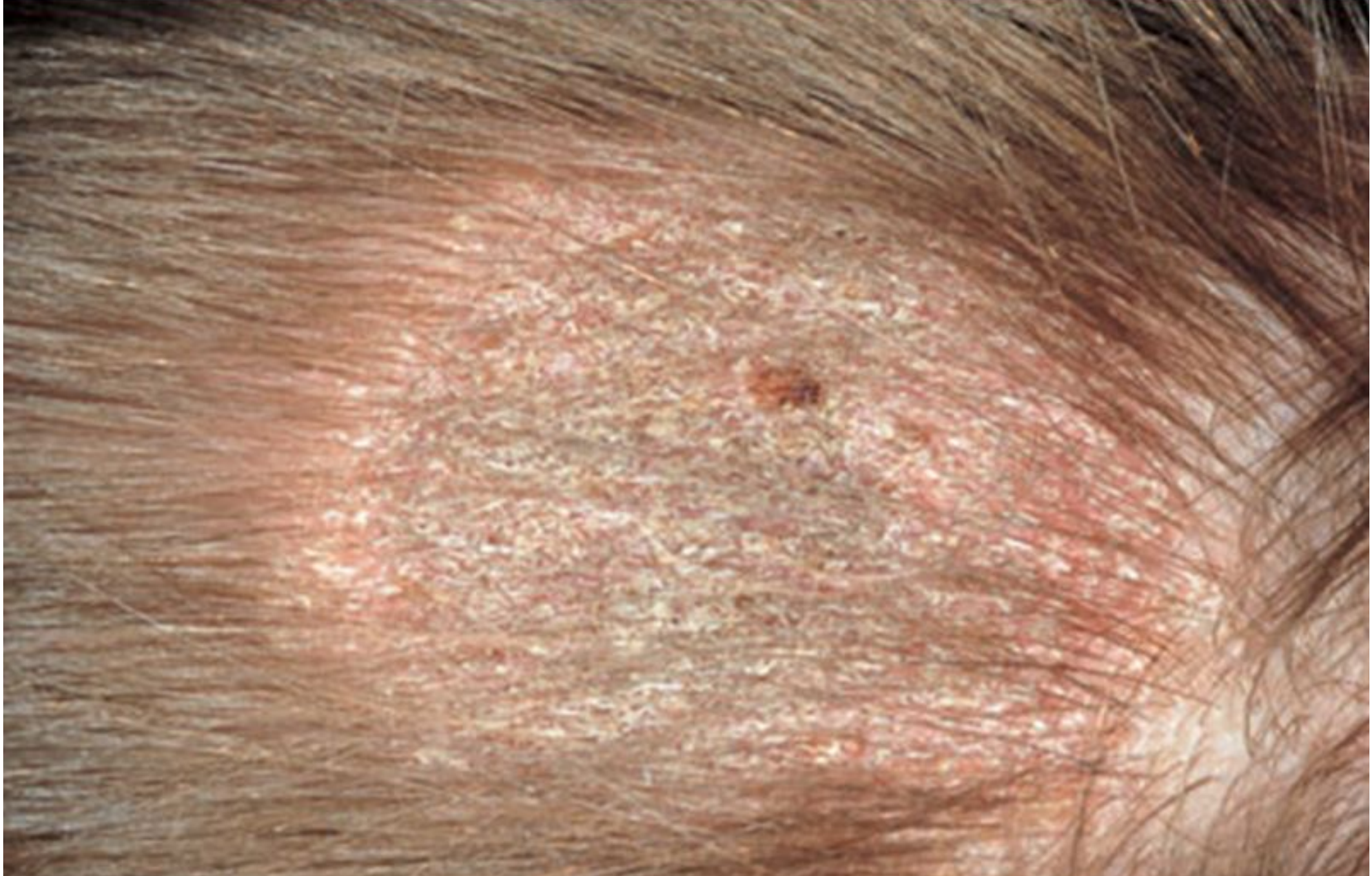
# Tinea capitis

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- Inflammatory variant:
  - Diffuse pustular: patchy alopecia with associated pustules or folliculitis.
  - Kerion: a painful, erythematous plaque, with associated alopecia and scattered pustules usually caused by a zoophilic species; may result in permanent alopecia
  - Favus: chronic inflammatory infection caused by *T. schoenleinii* characterised by matted hair and formation of yellow, crusted cup-shaped lesions (scutula) around the base of the hairs









# Tinea unguium

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- Onychomycosis - fungal infection of the nails
- Tinea unguium - dermatophyte infection of the nails (about 75% of all onychomycosis cases)
- Risk factors: age > 65 years, diabetics, immunodeficiency, athletes, occlusive footwear, hyperhidrosis
- Most cases are due to *T. rubrum* and *E. floccosum*

# Tinea unguium

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- Clinical features:
  - Subungual hyperkeratosis
  - Crumbling of the free end of the nail plate
  - Discolouration of the nail, (yellow, white, grey, or green)
  - Ridging, crumbling, and sometimes eventual complete nail plate destruction
  - Scaling on the plantar skin and web spaces due to associated tinea pedis



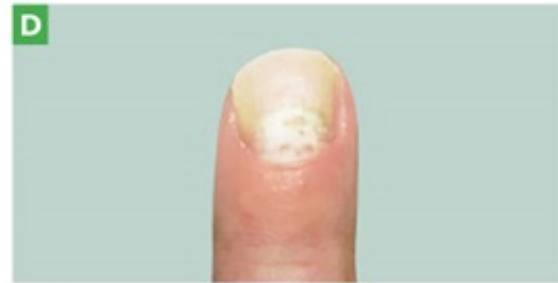
**A** Where onychomycosis (OM) infects the underneath of the nail plate, the infection produces a thick nodule (hyphae) that contains clusters of branching filaments called dermatophytoma.



**B** Distal lateral subungual OM is the most common type of OM. It is characterised by the build-up of soft yellow keratin between the nail plate and nail bed.



**C** White superficial OM is characterised by distinct white 'islands' on the nail surface.



**D** Endonyx OM is indicated by white milky patches without subungual hyperkeratosis.



**E** Proximal subungual OM is characterised by white discoloration and paronychia with discharge.



**F** Total dystrophic OM is the most advanced type that invades the nail plate, nail bed and nail matrix, causing severe dystrophy.





# Candidiasis

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- Infections caused by *Candida* spp. (***C. albicans***, *C. tropicalis*, *C. parapsilosis*)
- Predisposing factors: infancy or old age, warm climate, occlusion, broad-spectrum antibiotic treatment, diabetes mellitus, underlying skin disease



# Candidiasis

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- Oral candidiasis
- Angular cheilitis
- Vulvovaginal candidiasis
- Balanitis
- Intertrigo
- Chronic paronychia
- Onychomycosis (nail plate infection)

# Intertrigo

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- Superficial skin-fold infection caused by Candida
- Erythematous and macerated plaques with peripheral scaling, often associated with superficial satellite papules or pustules
- Skin folds below the breasts or under the abdomen, armpits and groin, web spaces between the fingers or toes





# Oral candidiasis

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- Several clinical manifestations:
  - Acute pseudomembranous candidiasis
    - White patches on gums, tongue and inside the mouth that can be peeled off leaving a raw area
  - Acute atrophic candidiasis
    - Smooth red shiny patches on the tongue, soreness of the mouth
  - Chronic atrophic candidiasis
    - Common in patients with dentures, the underlying mucosa is red and swollen



# Angular cheilitis

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- Sore red splits at each side of the mouth, more likely if there is an overhang of the upper lip over the lower lip causing a moist deep furrow
- More frequently in patients taking isotretinoin





# Vulvovaginal candidiasis

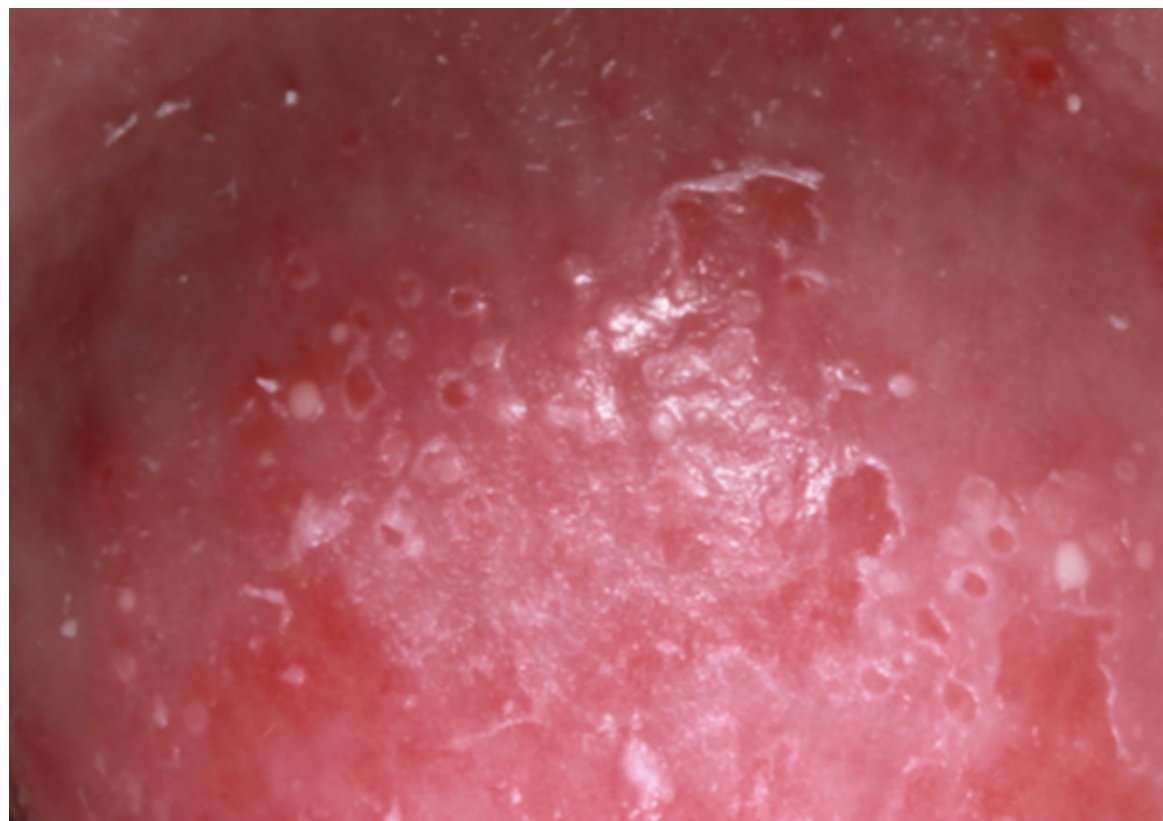
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- Genital Candida infection in women
- Up to 75% of women have at least one episode in life
- Dense white curd or cottage cheese-like vaginal discharge, bright red rash affecting inner and outer parts of the vulva, vulval edema and fissures, subjective symptoms (itching, pain, dysuria)

# Candidal balanitis

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- Penile infection caused by Candida
- The most common overall cause of balanitis
- Blotchy erythema with small red “satellite” papules or dry dull red areas, dysuria, pain



# Chronic paronychia

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- Chronic nail fold infection caused by *Candida*
- Risk factors: onychophagia, finger sucking (infants) ingrown toenails, application of artificial fingernails
- Clinical features: lost cuticle, proximal nail fold boggy and swollen, irregular and discoloured nail plate



# Pityriasis versicolor

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- Yeast infection caused by *Malassezia* spp. (most frequently *M. furfur*)
- Typically affects the trunk, neck, and/or arms
- Patches that may be coppery brown, paler than surrounding skin, or pink
- Sometimes associated with scaling and mild itch
- The term versicolor refers to the process in which the superficial scaly patches, pink on nontanned skin, become pale after exposure to sunlight



# Treatment of fungal infections

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- Topical (onychomycosis involving 1 nail, mild tinea corporis, tinea cruris, mild oral candidiasis, pityriasis versicolor)
- Systemic (tinea capitis, tinea barbae, onychomycosis of >1 nails, chronic/extensive tinea corporis, severe pityriasis versicolor)



# Azoles

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- Topical (ketoconazole, isoconazole) and systemic (fluconazole, itraconazole, voriconazole)
- Selectively damage the fungal cell wall (fungicidal effect), but not human cell membranes
- Effective against yeasts and dermatophytes

# Allylamines

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- The allylamine class of antifungal agents includes terbinafine (systemic activity) and naftifine (topical agent)
- Squalene epoxidase inhibition with resultant decrease in ergosterol and an increase in squalene within the fungal cell membrane
- Active in most fungal skin infections caused by dermatophytes and yeasts

# Polyenes

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- Nystatin and amphotericin B
- Bind to ergosterol and form aqueous pores in the cell membrane of fungi that promote leakage of intracellular ions and disrupt active transport mechanisms dependent on membrane potential
- Nystatin is used topically and systemically
- Amphotericin B is used in severe systemic fungal infections

