Fungal Infections

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Abstract

In this chapter, the authors present a variety of skin disorders associated with fungal infections such as adult atypical favus; kerion caused by *Microsporum nanum*; dermatophytosis of the groin, scrotum, and penis; Majocchi's granuloma on the face; disseminated deep dermatophytosis; tinea manuum nigra; blaschkoid tinea versicolor; cutaneous candida granuloma and cervical lymphadenitis; chronic mucocutaneous candidiasis; disseminated cryptococcosis; sporotrichosis presenting with multiple nodules; lymphangitic chromoblastomycosis; cutaneous basidiobolomycosis; primary cutaneous actinomycosis of the hand; human cutaneous protothecosis caused by *Prototheca zopfii*; actinomycetoma caused by *Nocardia brasiliensis*; primary cutaneous mucormycosis caused by *Rhizomucor variabilis*; cutaneous alternariosis; and skin granuloma due to fusarium.

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3.1 Adult Atypical Favus [1]

- Most favus is caused by *Trichophyton schoenleinii*, which preferentially infects the scalp and rarely the glabrous skin and nails. This condition occurs during childhood or adolescence and may persist to adulthood if an effective treatment is lacking.
- Clinically, the classic favus exhibits many yellowish cup-shaped crusts between 0.5 and 1.5 cm in diameter on the scalp. Subsequently, these lesions coalesce into a straw-colored, crisp favic crust. Finally, the involved scalp presents severe alopecia.
- Favus has many clinical variants, including atypical favus, which is similar to seborrheic dermatitis, psoriasis, and tinea amiantacea. Diagnosis is currently based on the mycological examination of the parasitized hair and scutula.
- It is important to diagnose atypical favus at an early stage to prevent the ultimate scarring alopecia.

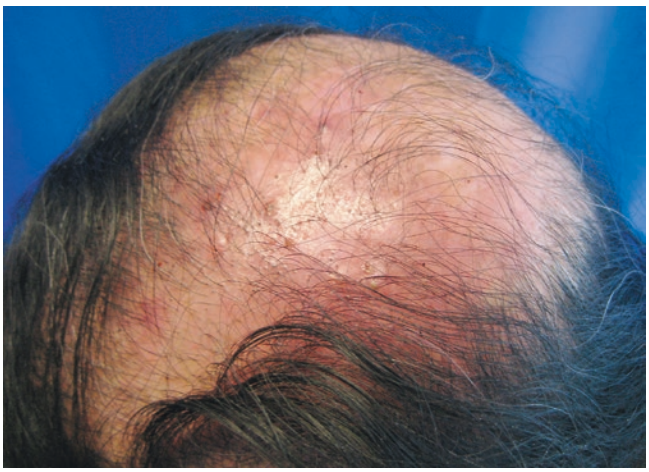


Fig. 3-1-1 A 55-year-old woman suffered from baldness for 50 years. A large, glossy, thin, and paperwhite atrophic lesion presented on the vertex with fine scales

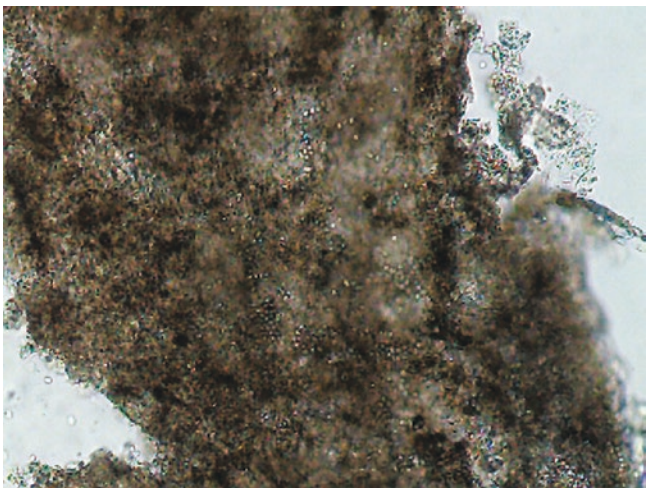


Fig. 3-1-2 Numerous microspores of endothrix were found by microscope

3.2 Kerion Caused by *Microsporum nanum* [2]

- Kerion is an inflammatory type of tinea capitis caused by a T cell-mediated hypersensitive response to the causative dermatophyte and characterized by a tender, erythematous, suppurative swelling with associated alopecia and regional lymphadenopathy.
- *Microsporum nanum* is a dermatophyte that can cause human and animal disorders. It rarely infects human, and it is most frequently relevant to ringworm infection in pigs.
- There are two involvement patterns (endothrix and ectothrix). Ovoid or pear-shaped macroconidia with small projections and collarettes on the shaft can be observed.

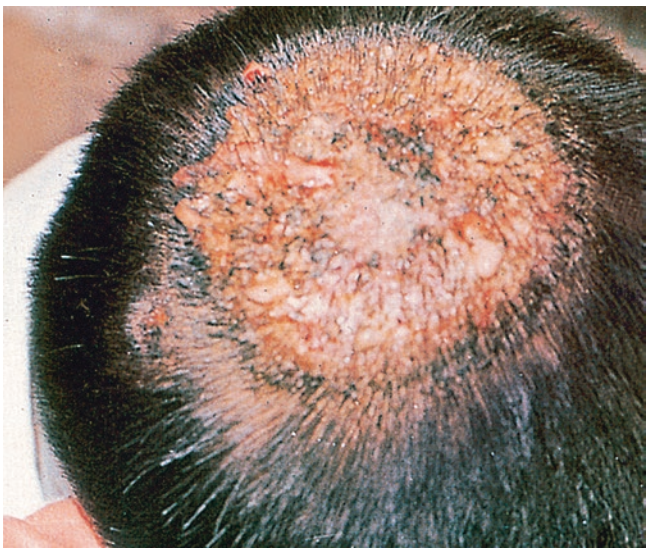


Fig. 3-2-1 There is an inflammatory plaque exuding pus on the vertex

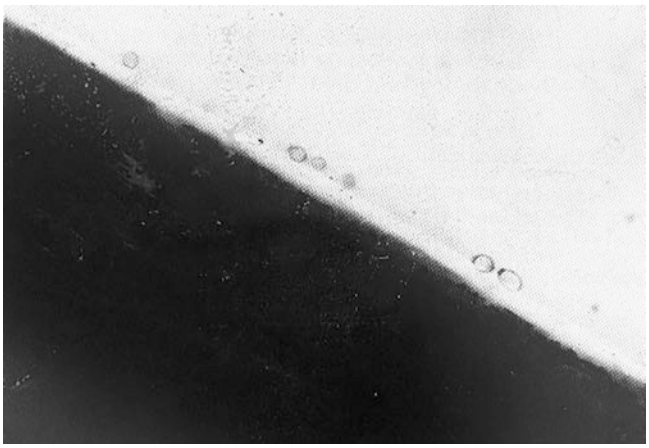


Fig. 3-2-2 Ovoid spores with sparse small projections on the shaft of infected hair (×800) (Reproduced with the permission from [21])

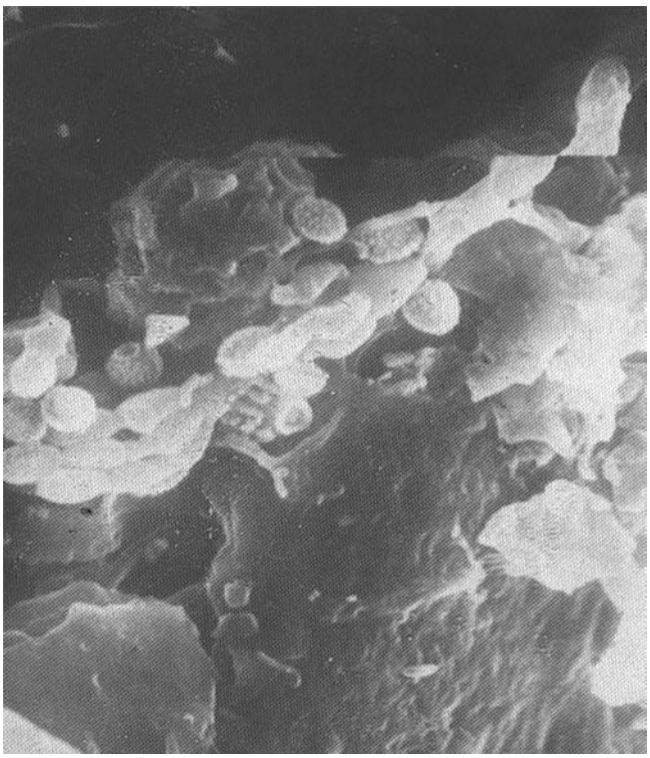


Fig. 3-2-3 Numerous ovoid or pear-shaped macroconidia with sparse small projections and collarettes on the shaft by SEM (Reproduced with the permission from [21])

Fig. 3-2-4 Macroconidia with sparse small projections and collar in culture by SEM (Reproduced with the permission from [21])

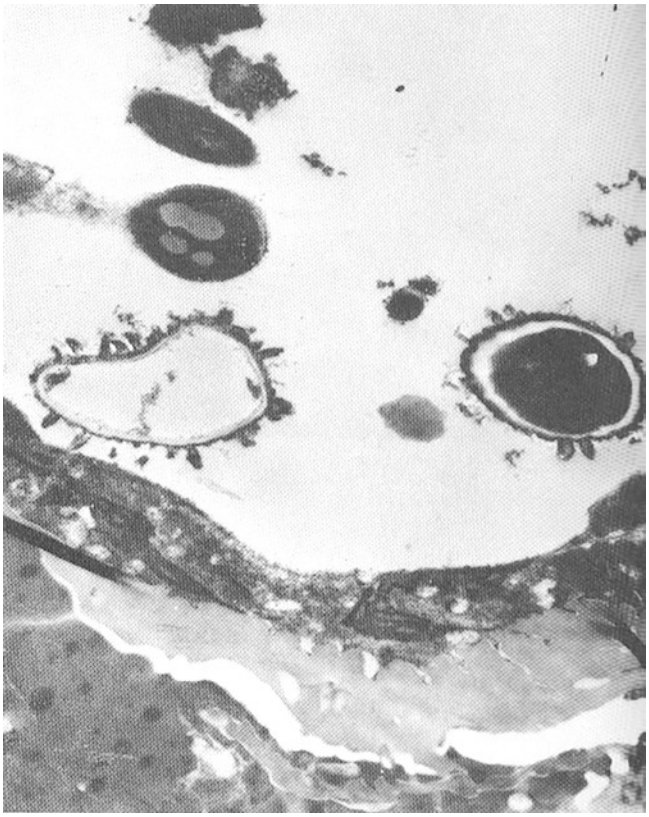
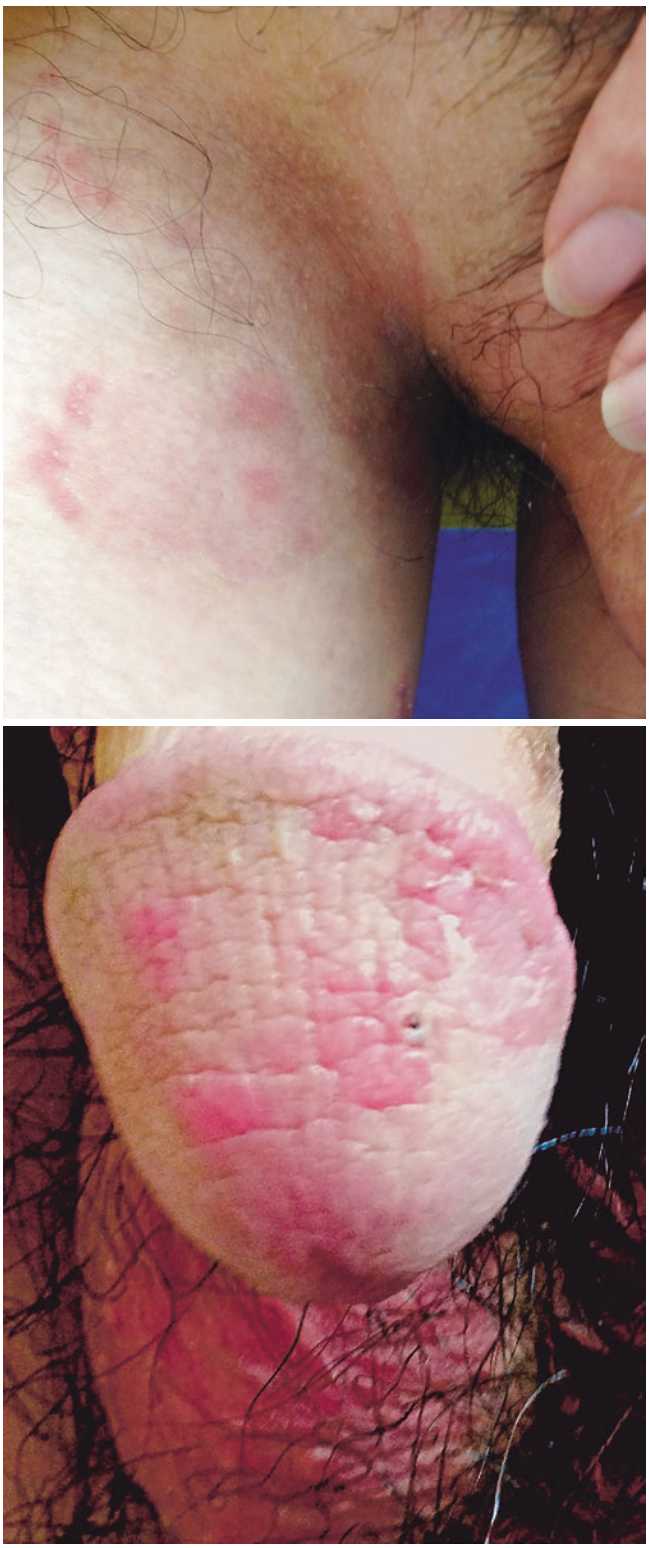


Fig. 3-2-5 Macroconidia has villus-like projections with electron dense areas on the surface of infected hair by TEM (×8000) (Reproduced with the permission from [21])

3.3 Dermatophytosis of the Groin, Scrotum, and Penis [3]

- Tinea cruris is caused by body ringworm and occurs in specific parts of the body, including the groin, perineal region, anus, and buttocks. It is commonly caused by *Trichophyton rubrum*, which is one of the most prominent anthropophilic species of dermatophytes.
- The characteristic lesion exhibits as central intact region surrounded by a scaly, red, advancing, elevated border.
- Tinea cruris rarely appears in the glans penis and scrotum. Genital shaving and concurrent athlete's foot and tinea unguium are predisposing factors.



Figs. 3-3-1, 3-3-2 Scaly erythemas with clear and raised margins of bilateral groin and the glans of the penis

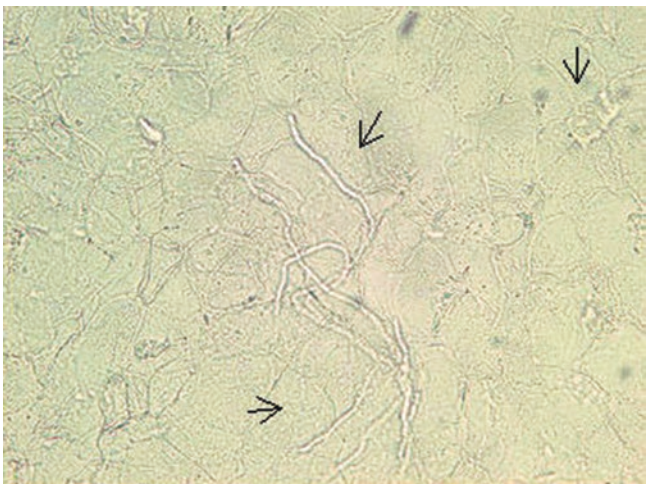


Fig. 3-3-3 Branchingmycelium was found by microscope examination (×40)

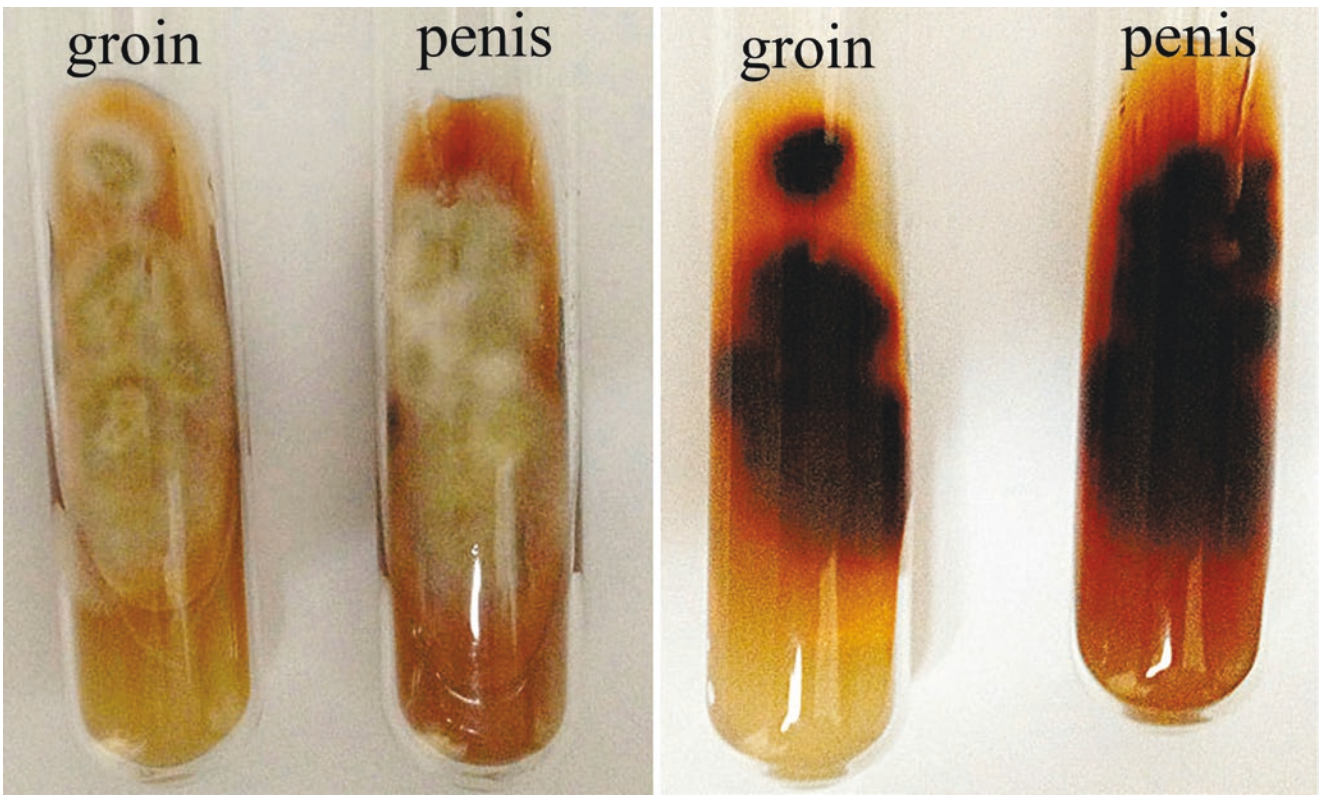


Fig. 3-3-4 The colony was incubated on Sabouraud dextrose agar at 23 °C for days. The color of the medium became port wine (right) from white (left)

3.4 Majocchi's Granuloma on the Face [4]

- Majocchi's granuloma (MG) is a persistent suppurative folliculitis related to a deep granulomatous reaction that is commonly caused by *Trichophyton rubrum* and may develop in any hair-bearing skin, frequently in areas that are prone to trauma. It exhibits nodules, plaques, and papules.
- In healthy individuals and immunocompromised hosts, MG has two clinical presentations: follicular papules and subcutaneous nodular types.
- Diagnosis is confirmed through histopathology, during which granulomas and dermatophytes in the form of filaments or spores are observed in the mid and deep dermis.

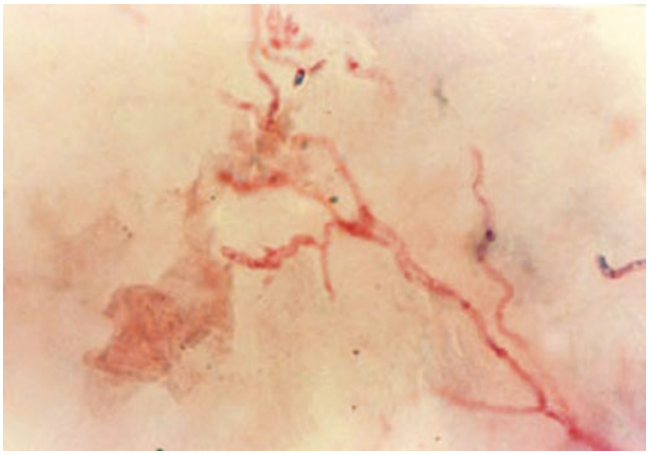


Fig. 3-4-2 Slide showing mycelium

Fig. 3-4-1 Numerous dark red infiltrate plaques and verrucous nodules associated with crusts on the face and scalp

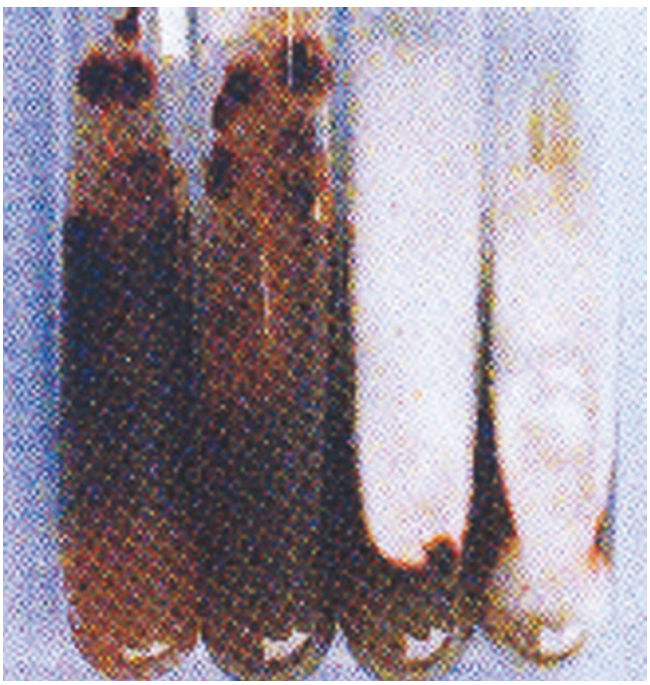


Fig. 3-4-3 Cultures of *Trichophyton rubrum*

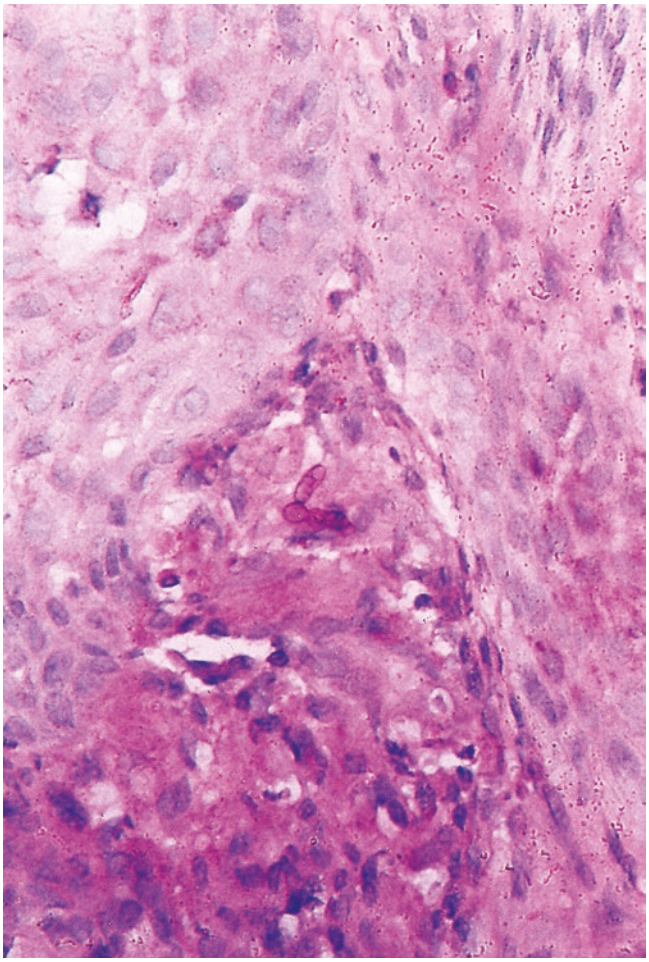


Fig. 3-4-4 Hyperkeratosis and acanthosis; neutrophils, eosinophils, plasma cell, and epithelioid cells infiltrated in the dermis with multinucleated giant cells, fungal spores, and hyphae (PAS stain)

3.5 Disseminated Deep Dermatophytosis [5]

- Disseminated deep dermatophytosis is an uncommon presentation of *Trichophyton rubrum* infection that specifically occurs in immunosuppressed patients.
- Clinically, this condition presents dermal nodules and shiny, skin-colored papules. Pleomorphic, broad hyphae with scattered budding arthrospores can be observed in the dermis. Granulomatous changes are also observed upon histopathological examination.
- For patients who are preparing for immunosuppressive treatment, consideration should be given to appropriately evaluate and treat superficial dermatophytosis.

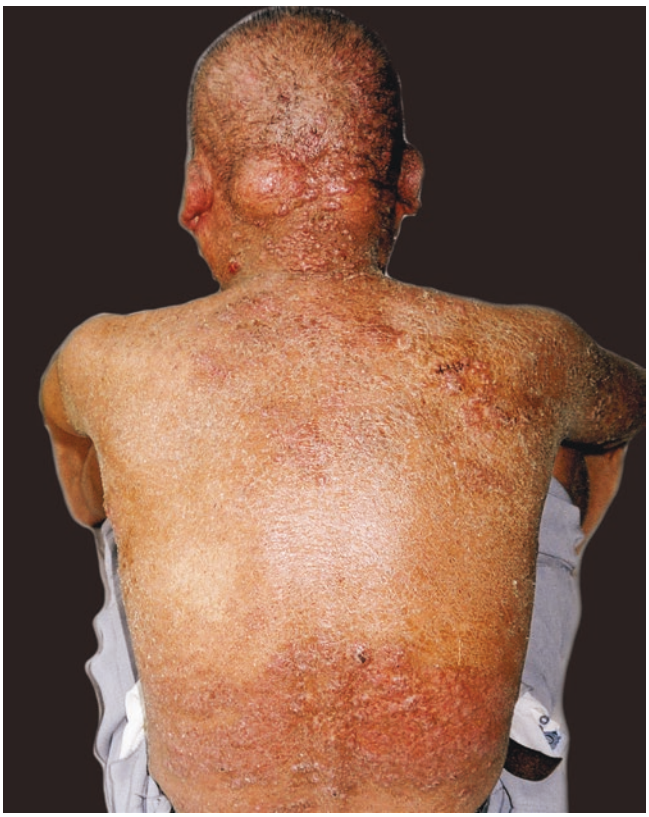


Fig. 3-5-1 Sparse hair, patchy hair loss areas, and dark erythemas with obvious infiltration appeared on the head; two egg-sized masses presented on the occipital area. Variously sized plaques and gray, red, or dark black patches distributed on the trunk and extremities

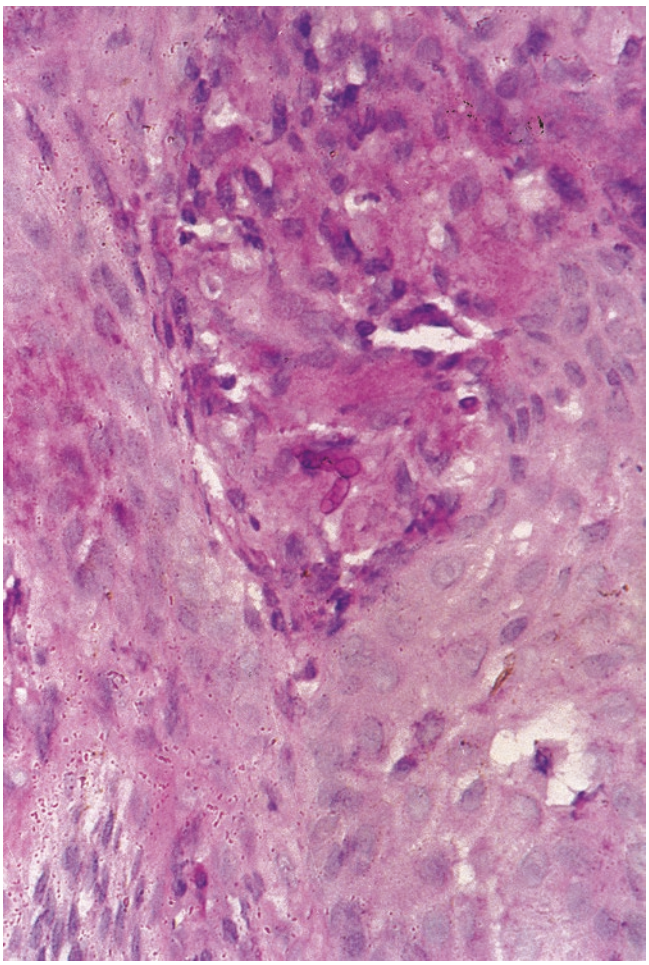


Fig. 3-5-2 The pathological changes of the lesion showed fungal spores and hyphae in the tissue (PAS stain, ×200)

3.6 Tinea Manuum Nigra [6]

- Tinea nigra, an extremely rare mycosis, is commonly caused by *Hortaea werneckii*.
- The most common predisposing factors include hyperhidrosis and living in coastal regions or hypersaline environments.
- The lesions are characterized by pigmented, macular patches on the palms or soles, similar to pigmentary lesions such as melanoma, particularly when they exist as a solitary lesion.
- Once suspected, this condition is easy to diagnose by a simple KOH and dermoscopic examination or culture. Thus, the patient can avoid unnecessary interventions such as biopsy.

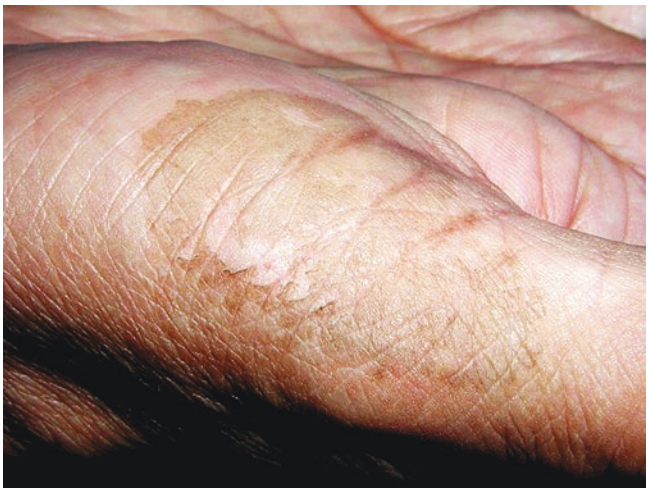


Fig. 3-6-1 A big light/dark macule on the right palm

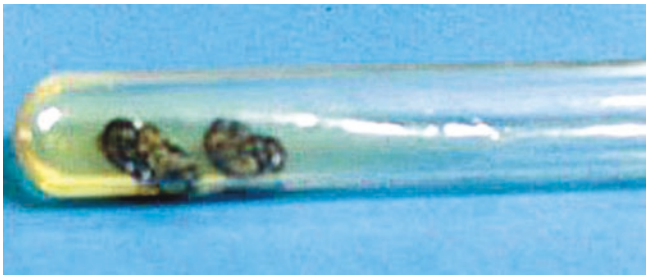


Fig. 3-6-2 A black yeastlike colony on the medium

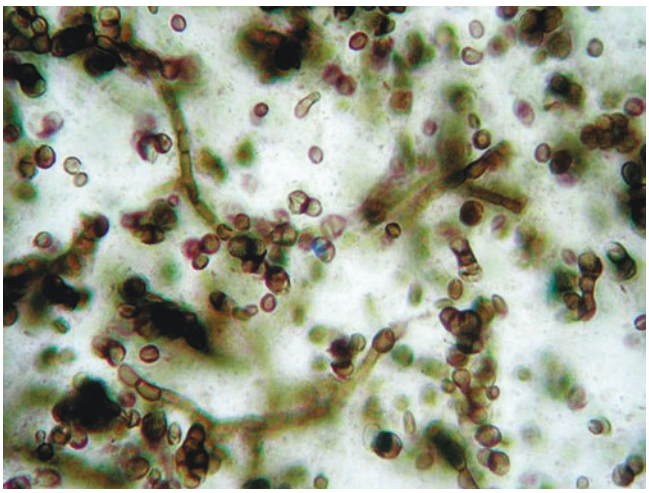


Fig. 3-6-3 Brown septate hyphae and lots of chlamydospores under the microscope (cotton blue stain, ×40)

3.7 Blaschkoid Tinea Versicolor [7]

- Tinea versicolor (TV) is a conventional cutaneous fungal infection with well-delineated macules that are demarcated, round, or oval.
- The color can be pink, tan, brown, purple, black, or hypopigmented. An overlap of the different colored lesions causes a prominent trichromatic change.
- It is most normally encountered in sebum-rich areas such as the chest, shoulders, and upper back. Although uncommon, eruptions confined to the face and scalp, arms and legs, intertriginous sites, genitalia, areolae, and palms and soles have also been noted.
- At least seven clinical variants have been identified, consisting of pigmented, leukodermic, erythematous, atrophic, confetti-like, follicular, and blaschkoid subtypes.

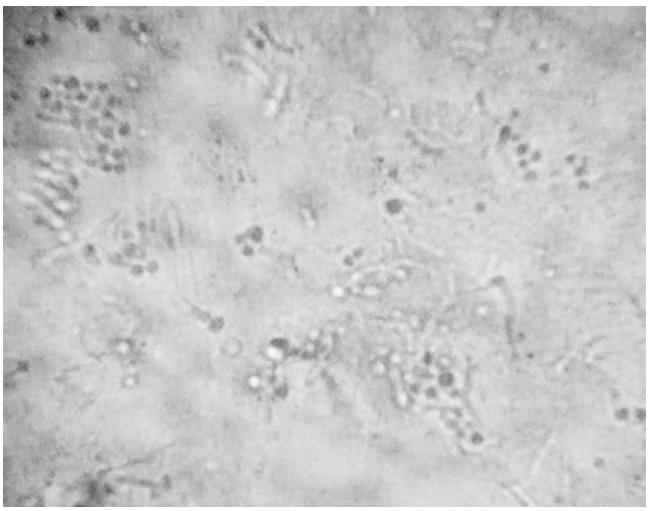


Fig. 3-7-2 Direct mycological examination showed slender septate hyphae and spores with spaghetti and meatball appearance (×40) (Reproduced with the permission from [22])

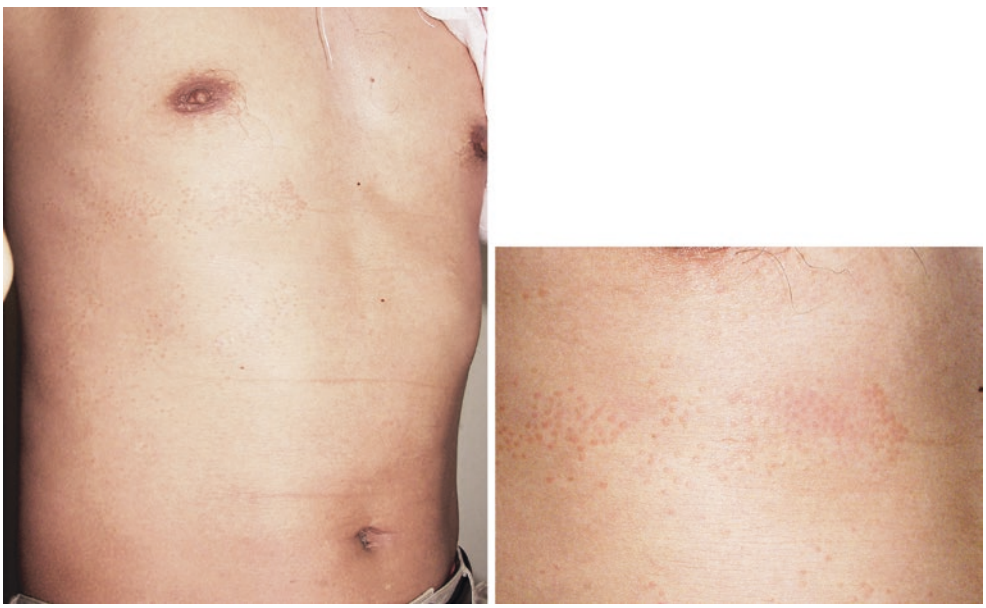


Fig. 3-7-1 On the right chest, there were numerous follicular brownish-red maculopapules, giving several S-shaped band-like appearances (type 1b Blaschko's lines) (Reproduced with the permission from [22])

3.8 Cutaneous Candida Granuloma and Cervical Lymphadenitis [8, 9]

- Granulomatous skin lesions infected by *Candida albicans* are manifestations of a rare form of generalized mucocutaneous candidiasis that has also been described in patients with impaired cell-mediated immunity.
- The mouth, face, fingernails, and scalp are the most familiar areas. Early diagnosis mainly depends on the clinical setting and signs and on proper interpretation of the culture data.
- The involvement of lymph nodes in patients who suffer from disseminated candidiasis has been considered to be a rare occurrence.
- Early and adequate antifungal therapy and improved immunity to remove the pathogenic bacteria and control disease should be emphasized.

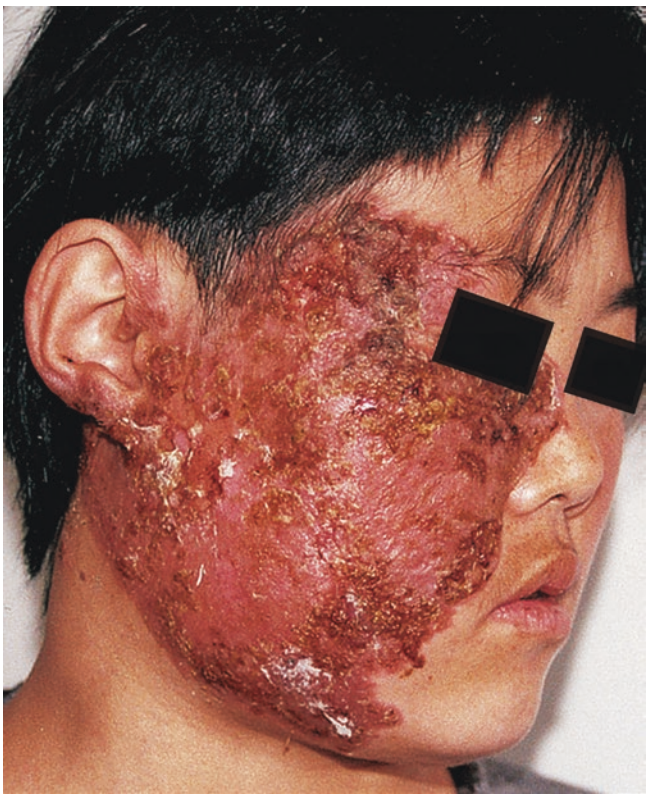


Fig. 3-8-1 Brownish-red neoplasm and granuloma on the face (Reproduced with the permission from [8, 9])

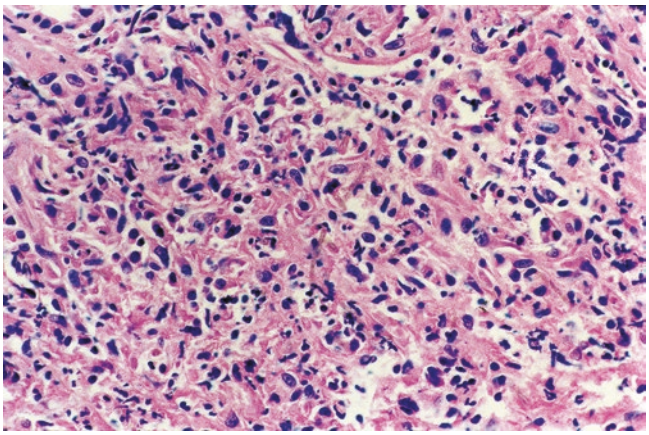


Fig. 3-8-2 Numbers of mycelial filaments in the granuloma tissue (HE stain, ×200)

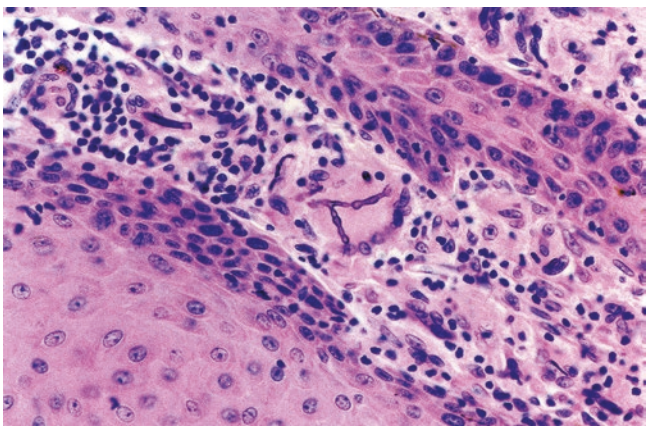
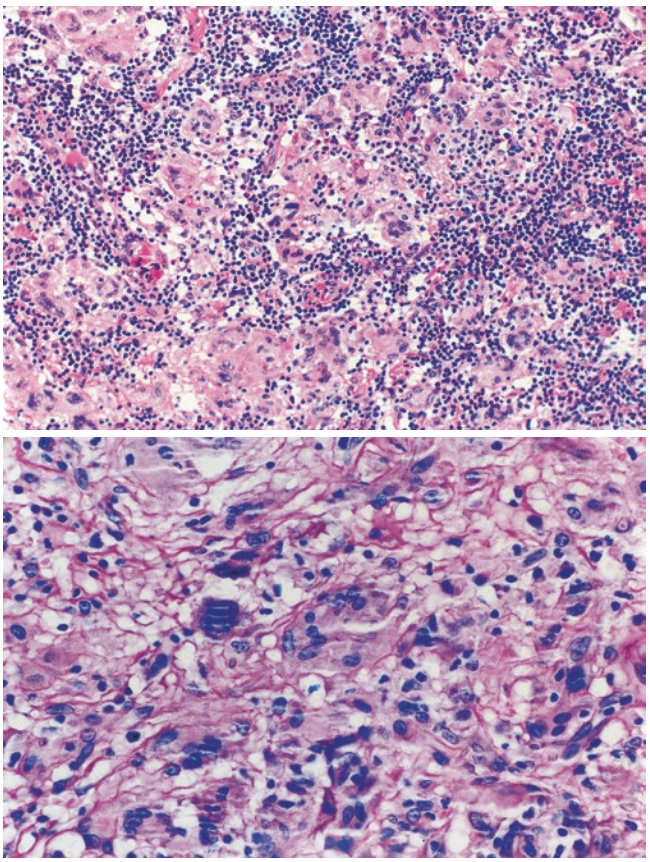


Fig. 3-8-3 Numbers of inflammatory infiltrates and granulomas in the dermis, numbers of mycelial filament in and outside of giant cells (HE stain, ×400)



Figs. 3-8-4, 3-8-5 Numbers of candidal granulomas in the lymph node (HE stain, (4) × 100, (5) × 400)

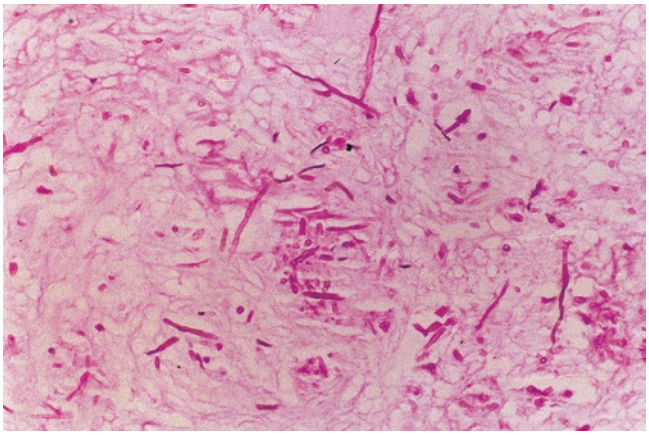


Fig. 3-8-6 Numbers of mycelia filaments in and outside of cells (PAS stain, ×100)

3.9 Chronic Mucocutaneous Candidiasis [10]

- Chronic mucocutaneous candidiasis (CMC) is often caused by *Candida albicans*, featuring recurrent or persistent infections affecting the nails, skin, and oral and genital mucosae.
- CMC is not a specific disorder but a phenotypic presentation of a spectrum of autoimmune, endocrinologic, and immunologic diseases. It is associated with cellular immune and leukocyte dysfunction due to thymic deficiency and usually occurs during infancy or early childhood (60–80% of cases).
- Adult or delayed onset of the disorder is related to bone marrow abnormalities, myasthenia gravis, and thymoma. Typical antifungal treatments are almost noneffective for CMC.

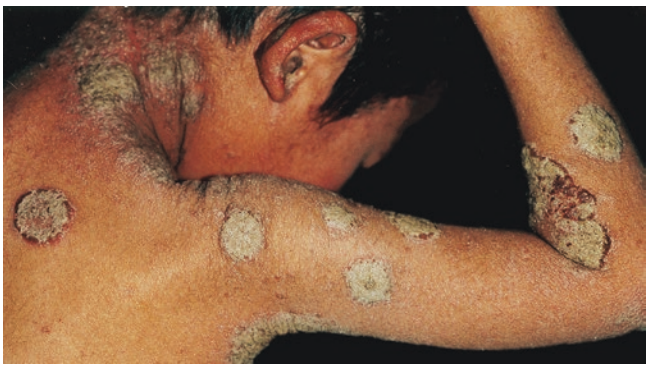


Fig. 3-9-1 Many dark red and brown patches covered with crusts and scales on the right arm

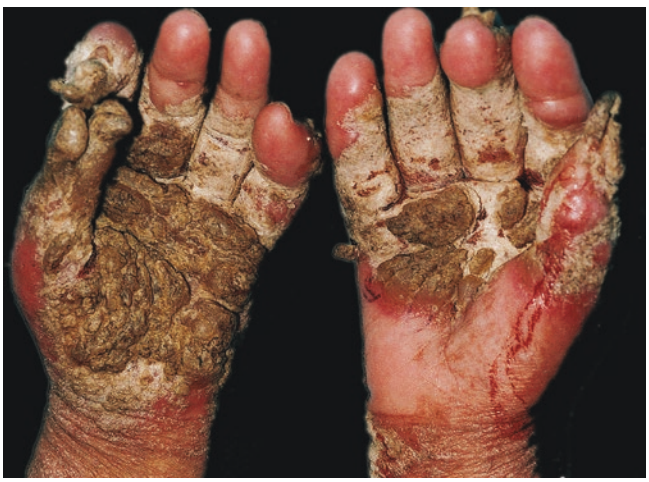


Fig. 3-9-2 Both metacarpophalangeal verrucous vegetation

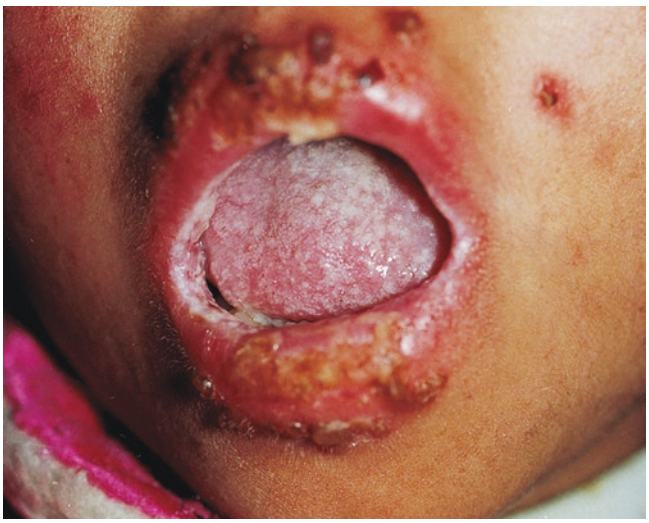


Fig. 3-9-3 Moniliasis of the tongue and lips

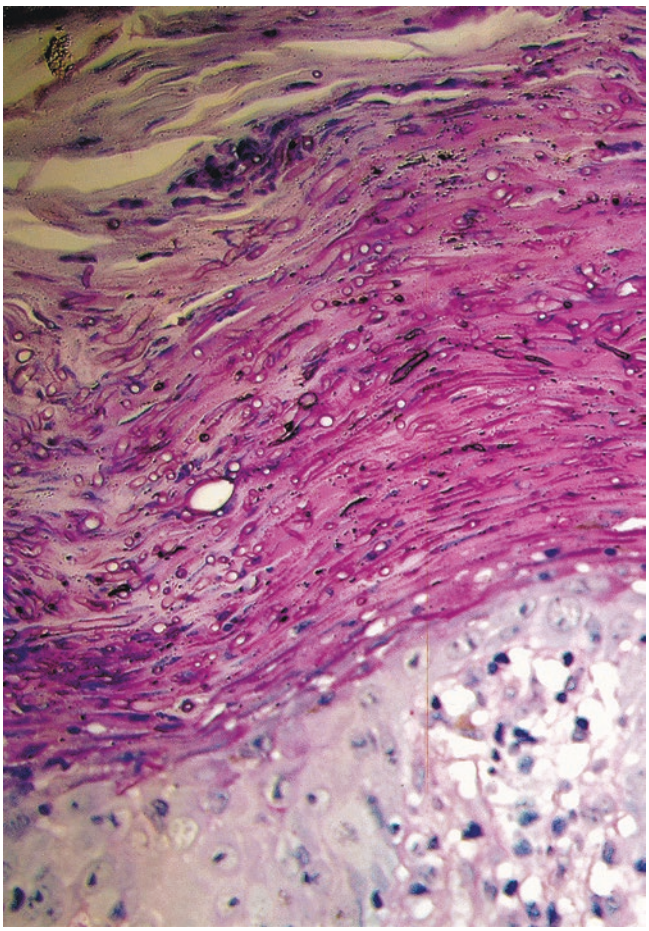


Fig. 3-9-4 Large hyphae and spores in keratotic layer of the epidermis (PAS stain, ×100)

3.10 Disseminated Cryptococcosis [11]

- Cryptococcosis is an opportunistic infection caused by *Cryptococcus neoformans* and tends to affect immunocompromised individuals. The disease is initiated mostly through inhalation of fungi and rarely through inoculation of the fungus via skin injury.
- Primary cutaneous cryptococcosis (PCC) is a rare condition that has been recognized since 2003. This condition results from local inoculation, usually presents as a single infiltrative lesion without systemic involvement, and provides a positive fungal culture.
- Cryptococcosis may spread through the blood, especially affecting the central nervous system (CNS) and skin, and is then called disseminated cryptococcosis (DC). The most familiar recognized area of DC is the central nervous system. Skin findings in DC indicate a poor prognosis.
- The choice of therapy is mainly dependent on the immunocompetence of the host and the extent of the disorder.

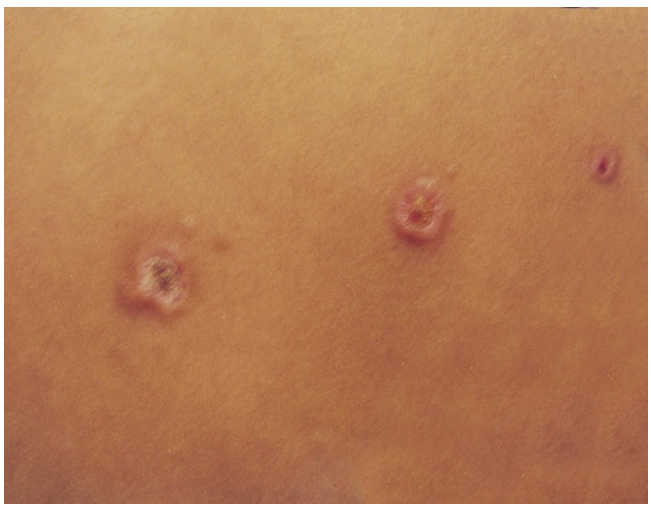


Fig. 3-10a-1 Three elevated papules and nodules with umbilicated centers on the back

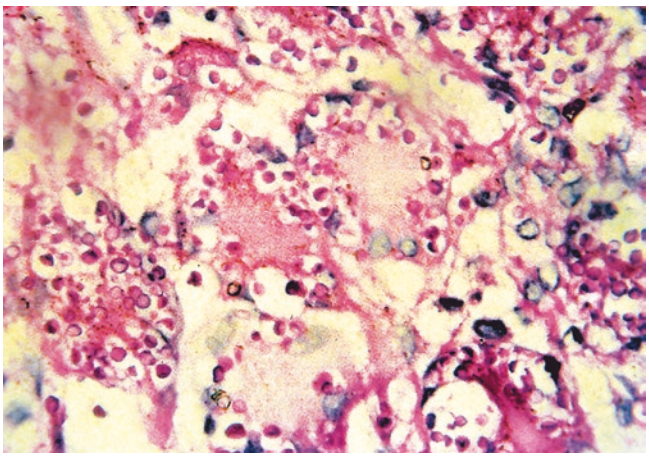


Fig. 3-10a-2 A large mass of spores located in or outside giant cells in the dermis (PAS stain, ×400)

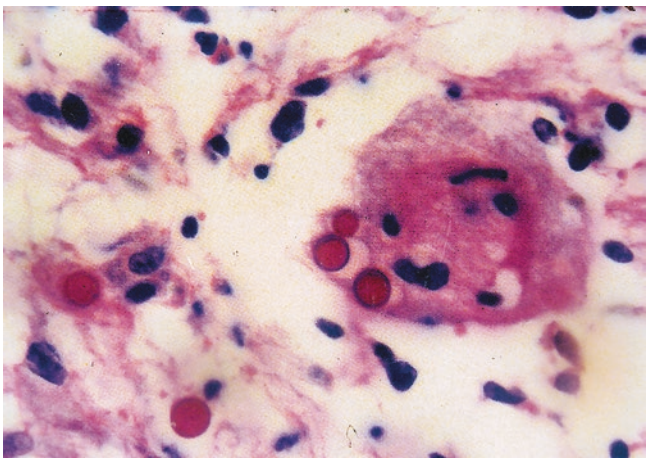


Fig. 3-10a-3 Three typical spores are present in a giant cell in the dermis (PAS stain, ×1300)

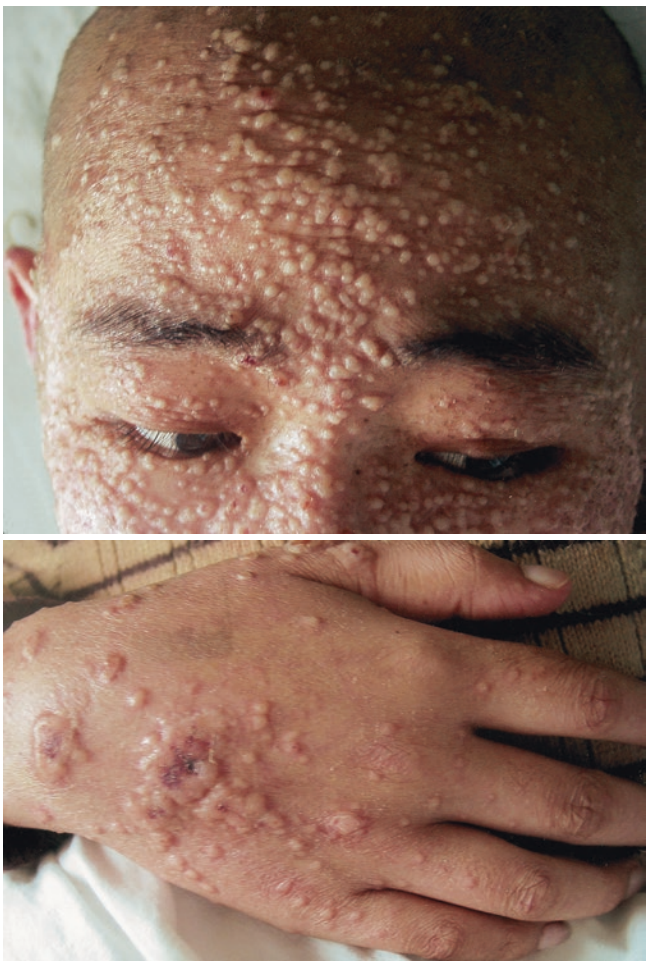


Fig. 3-10b-1, 3-10b-2 Multiple molluscum contagiosum-like skin lesions on the face (1) and forearm (2)

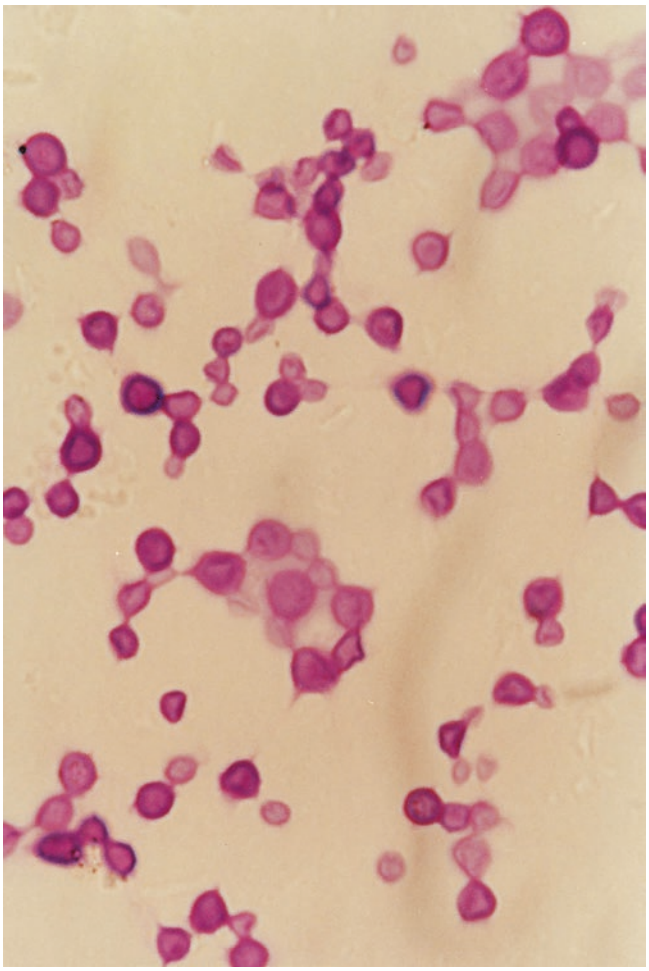


Fig. 3-10b-3 Large violet-red spores in the dermis (PAS stain, ×1000)

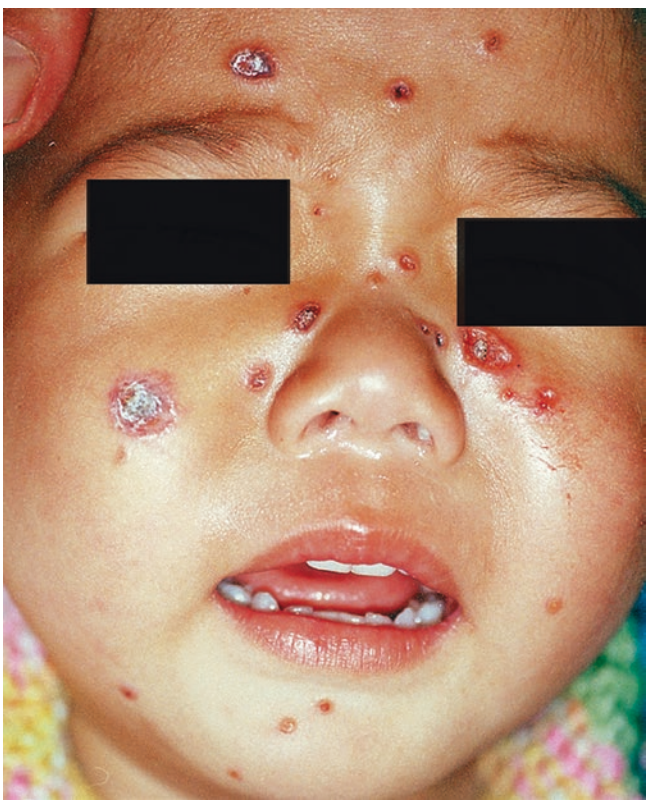


Fig. 3-10c-1 Papules resembling molluscum contagiosum on the face, some of them having necrosis, ulcers, and crust (Reproduced with the permission from [10])

Fig. 3-10c-2 Smears from CSF fluid showed the spore surrounded by a capsule, some of them budding (Indian ink stain, ×40)

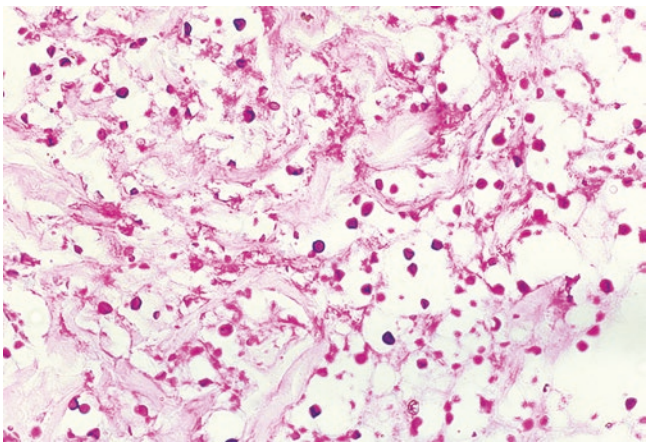


Fig. 3-10c-3 Numerous small round eosinophilic spores in the dermis, some of them budding (PAS stain, ×40)

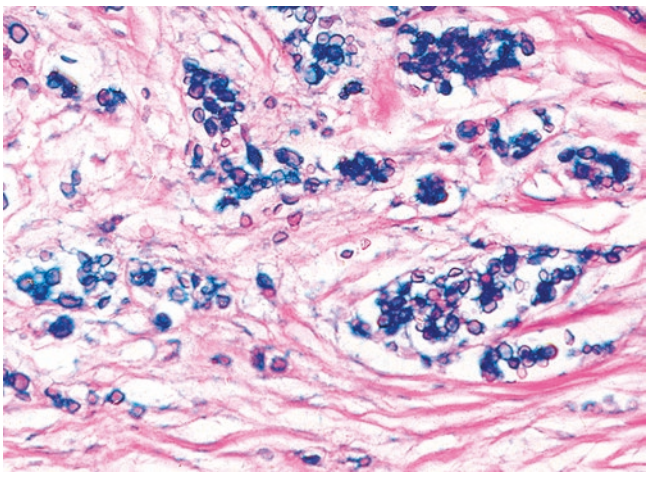


Fig. 3-10c-4 Alcian blue stain and the PAS reaction combined; the red spores surrounding blue capsules (Alcian blue-PAS stain, ×40)

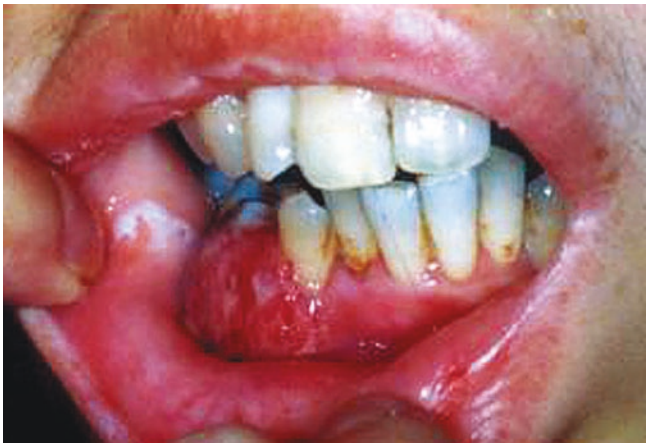


Fig. 3–10d-1 A nodule with ulcer sized 1.3 cm × 2.0 cm on the right lower gum

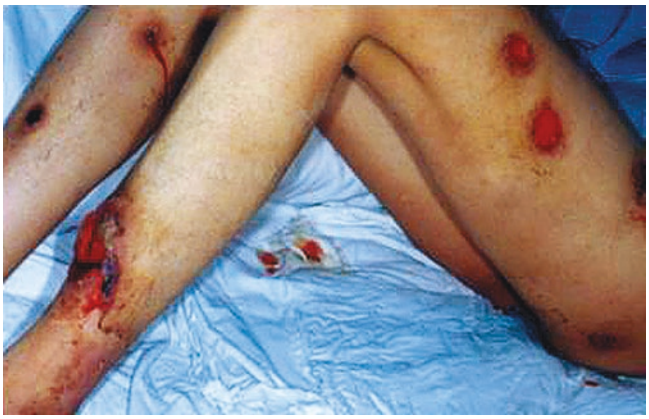


Fig. 3-10d-2 Nodules and ulcers with discharge on the extremities

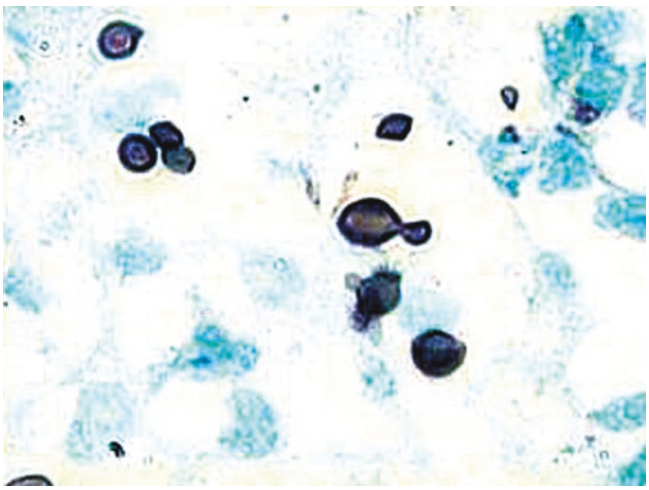


Fig. 3-10d-3 Microscopic examination of the tissue showed numerous budding yeast cells (stained with Gomori's methenamine silver, ×1000)

Fig. 3-10d-4 Transmission electron microscopy showed the section of spores was round or oval with buds (×12,000)

Fig. 3-10d-5 The colony was incubated on Sabouraud dextrose agar containing 20% urea of at 23 °C for 3 years. The color of the medium became port wine from white (left side), while the color of the control did not change (right side)

3.11 Sporotrichosis Presenting with Multiple Nodules [12]

- Sporotrichosis is a chronic granulomatous mycotic infection that results from *Sporothrix schenckii*, which is usually present in hay, decaying wood, soil, and sphagnum moss. Traumatic inoculation is the obvious cause of this disease, which does not discriminate by age, gender, or race but does show a preference for farmers, gardeners, florists, foresters, and nursery workers who often handle plants or plant material.
- This condition comprises four clinical types: lymphocutaneous, fixed cutaneous, multifocal or disseminated cutaneous, and extracutaneous sporotrichosis. The lymphocutaneous type is the most common and accounts for 70–80% of cases. This type is characterized by a noduloulcerative lesion (sporotrichotic chancre) at the inoculation site and a rope of semblable nodules along the proximal lymphatics.
- The primary therapeutic choice for uncomplicated cutaneous sporotrichosis is still a saturated solution of potassium iodide. Itraconazole, terbinafine, or amphotericin B is currently recommended for treating severe or systemic conditions.

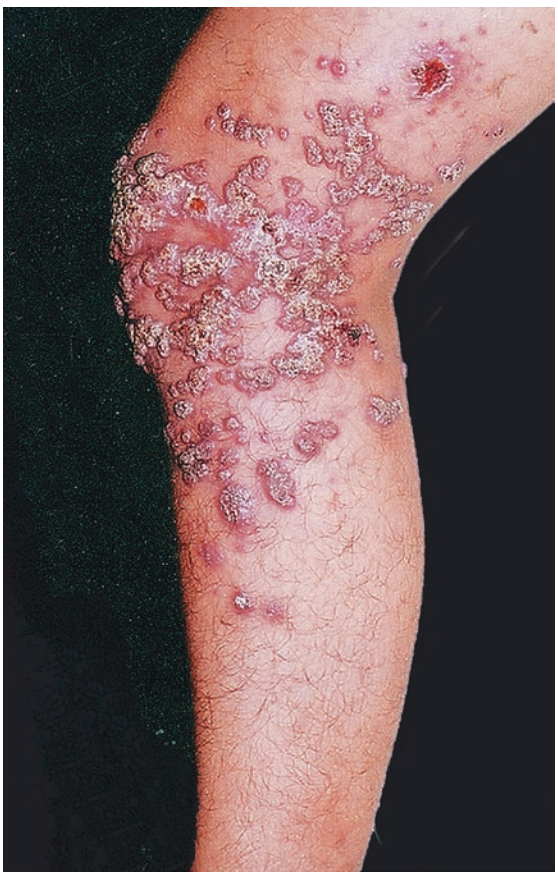


Fig. 3-11-1 Multiple nodules and plaques on the knees

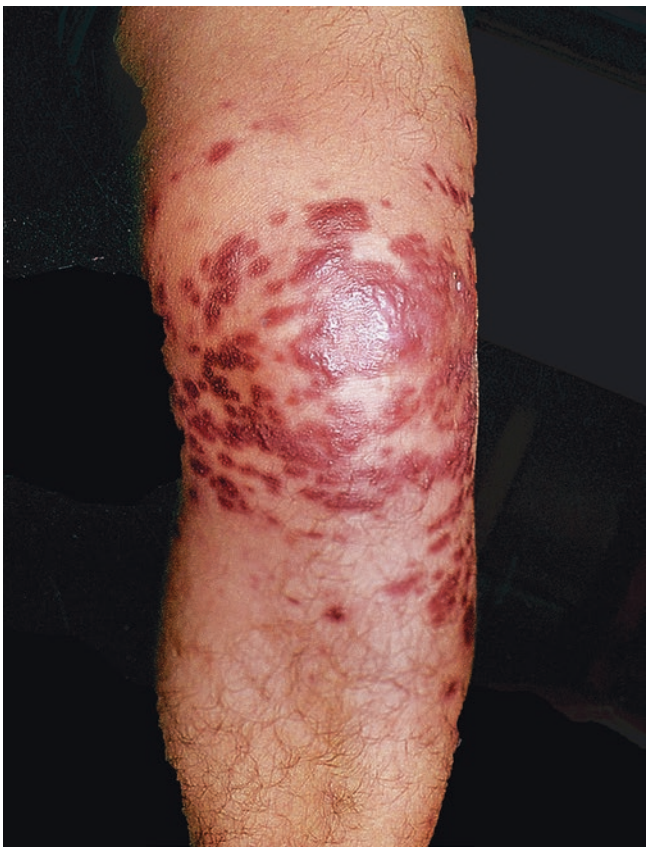


Fig. 3-11-2 Lesions flat with scars after treatment for 3 weeks

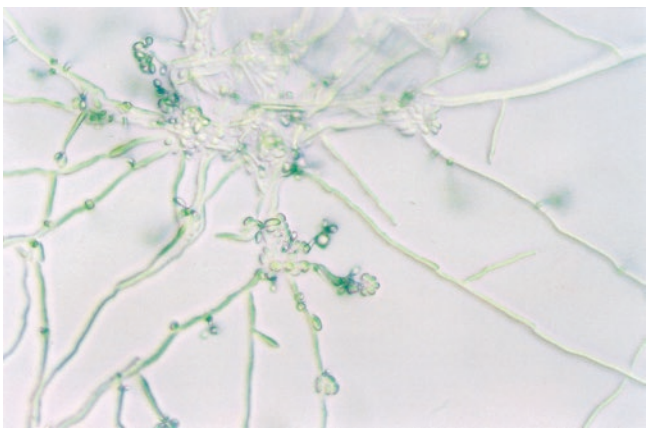


Fig. 3-11-3 Branching pyriform spores in culture (×40)

3.12 Lymphangitic Chromoblastomycosis [13]

- Chromoblastomycosis (CM) is a chronic granulomatous mycotic infection of the subcutaneous tissue and skin caused by pigmented fungi, which usually occurs on the exposed surfaces of the crus after trauma.
- The lesions can invade other sites by hematogenous spread, autoinoculation, or direct diffusion. The lymphatics may also play a role in disseminating the infection. Lesions spread along the lymphatic vessels, and new nodules emerge around the lesions.
- The CM lesion can be verrucous with central scarring or severe scarring with a serpiginous border that is indurated or scaly with fistula formation.
- The diagnosis should be confirmed either by direct microscopy of the scrapings from the lesion in 20% KOH when thick-walled, dark-brown tissue forms of the fungus are seen, by culturing the scrapings, or by histological examination of a biopsy specimen with a granulomatous reaction and spores or biopsy material.

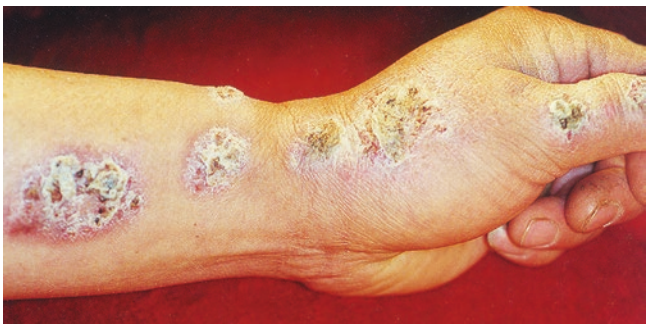


Fig. 3-12-1 Nodules distributed in lines with ulcer and crust from thumb

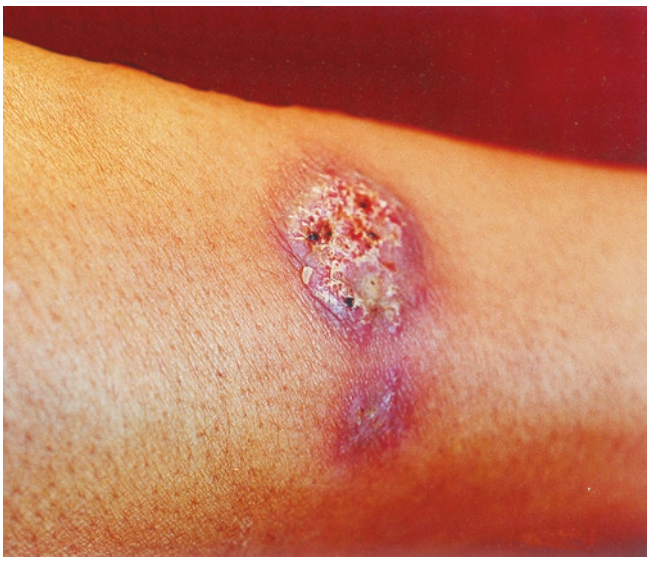


Fig. 3-12-2 Wine-colored plaques covered with yellow-white thickened crust and numerous black speckles

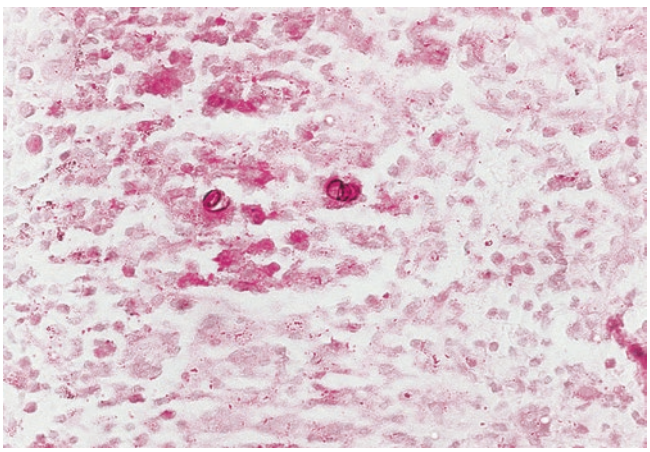
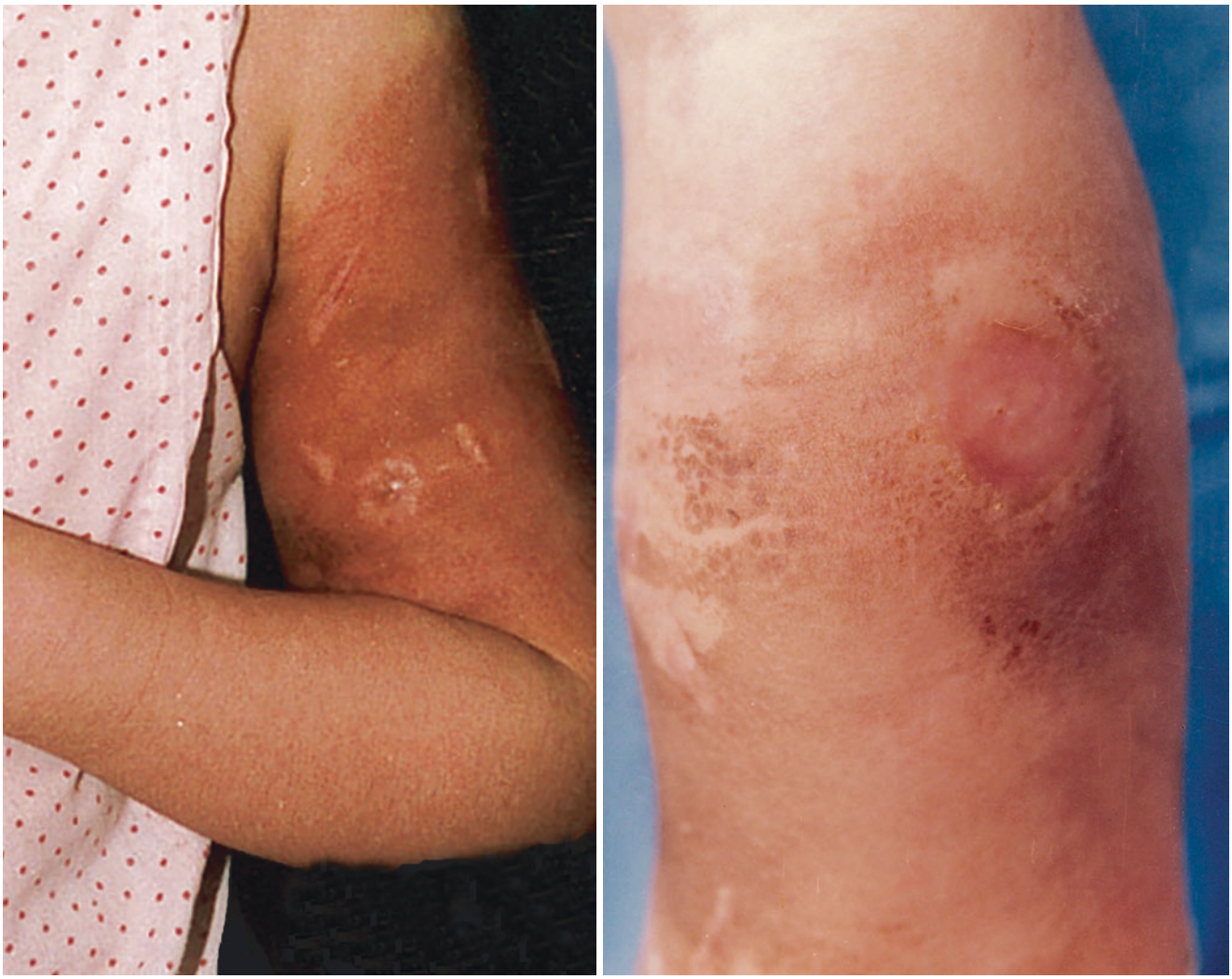


Fig. 3-12-3 Dark-brown thick-walled oval spores with crosswalls in tissue (PAS stain, ×400)

Fig. 3-12-4 *Phialophora verrucosa* in culture (PDA stain, ×200)

3.13 Cutaneous Basidiobolomycosis [14]

- Cutaneous basidiobolomycosis is particularly associated with *Basidiobolus ranarum* and classically presents as a noninflammatory, nonulcerated, nontender woody indurated mass without much contiguous spread, usually in immunocompetent children, less often in adolescents, and rarely in adults. It is mostly located on the trunk, shoulders, and upper part of the limbs, featuring rare small yellow coagula and a yellow line of fungal invasion under the edematous surface.
- Biopsy and fungal culture of the lesion can facilitate diagnosis. Early and precise diagnosis of basidiobolomycosis is vital to avoid dissemination and death.



Figs. 3-13-1, 3-13-2 The brown mass on the left upper arm

Fig. 3-13-3 The flushing erythemas which were softened and broken in the center, the yellowish granules and pus discharged from broken places

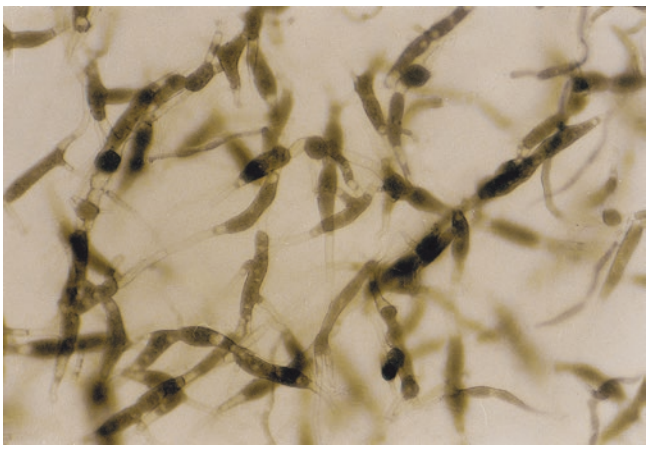


Fig. 3-13-4 The observation of fungal culture; before treatment of itraconazole, septate hyphae grew well, some of which expanded to form sporangia (×11,000)

3.14 Primary Cutaneous Actinomycosis of the Hand [15]

- Primary cutaneous actinomycosis is an uncommon clinical type with variable presentation, usually presenting as a chronic, localized infiltrative process with abscess, fistula formation, and draining sinuses.
- This condition is caused by *Actinomyces* and must be differentiated from tuberculosis, fungal infections, and malignancy, among others.
- The therapeutic regimen comprises surgical excision and an extended period of antimicrobial treatment.

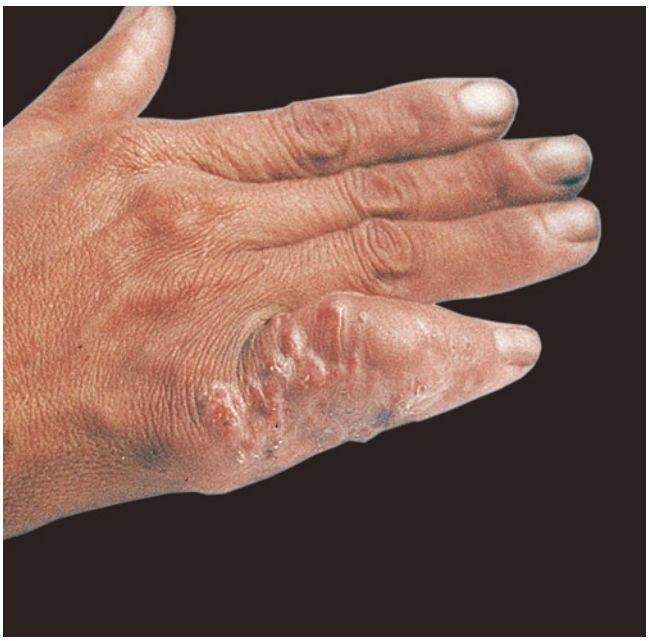


Fig. 3-14-1 Several abscesses in the skin of the swollen finger

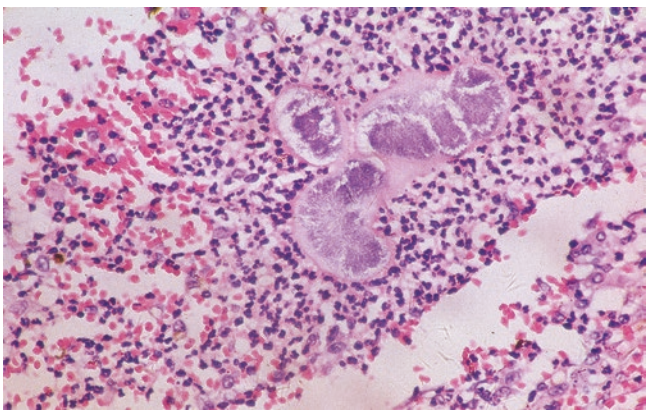


Fig. 3-14-2 *Actinomyces* in small abscesses (HE stain, ×100)

3.15 Human Cutaneous Protothecosis Caused by *Prototheca zopfii* [16]

- Protothecosis is an uncommon infection caused by the genus *Prototheca*, which are omnipresent in nature and in organic material. *Prototheca wickerhamii* and *Prototheca zopfii* are the most frequent organisms reported in humans.
- The disease is divided into three types: cutaneous, bursitis-causing, and disseminated/systemic conditions, affecting both immunocompetent and immunosuppressed patients, with more serious and disseminated infections occurring in immunocompromised individuals.
- Diagnosis is based on observing asexual sporangia (thecas) by histopathological examination. Medical and surgical treatment can be used. Ketoconazole, amphotericin B, fluconazole, posaconazole, voriconazole, and itraconazole are the most commonly administered antifungals.

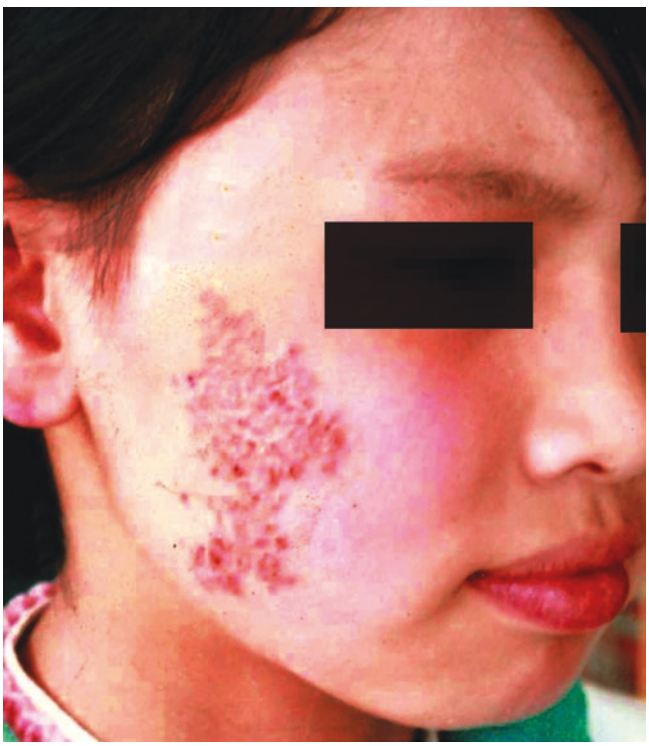


Fig. 3-15-1 The erythemas, papules, and scales occurred on the right side of her face (Reproduced with the permission from [16])

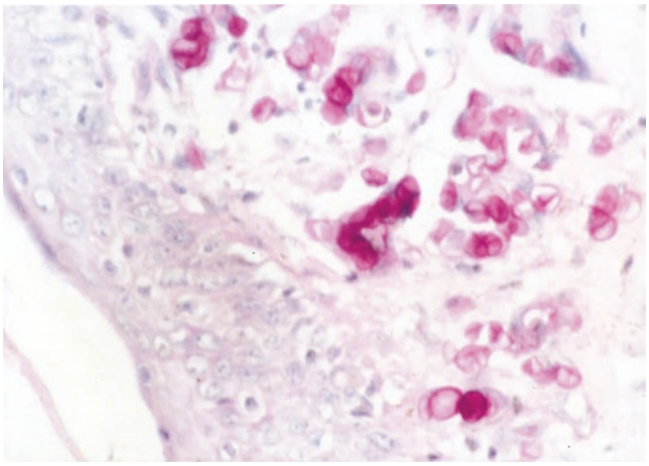


Fig. 3-15-2 A few monocytes infiltrated around the blood vessels and epidermal appendages in the upper dermis (PAS stain, ×100)

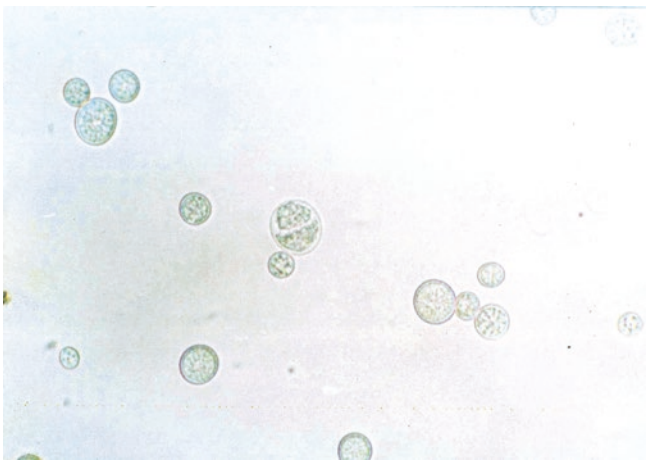


Fig. 3-15-3 A large quantity of chlamydospores (diameter 10–18 μm, some diameter 3–8 μm entosporum inside) were discovered, microscope view (×400)

3.16 Mycetoma Caused by *Nocardia brasiliensis* [17]

- Mycetoma is a chronic subcutaneous infection caused by aerobic branching actinomycetes through minor trauma in susceptible individuals. *Nocardia brasiliensis* is a common infectious agent.
- The clinical characteristics are firm tumefaction of the affected site and the presence of nodules, abscesses, and sinuses that expel a seropurulent exudate, including filamenting granules. The infection generally remains localized, but it may spread to the underlying bone and muscle or to adjacent organs.
- Treatment of *Nocardia* infections should be individualized. Standard treatment for uncomplicated cases is a few months of sulfamethoxazole-trimethoprim. Special locations, disseminated cases, and bone involvement must receive combined therapy with sulfamethoxazole-trimethoprim and amikacin.

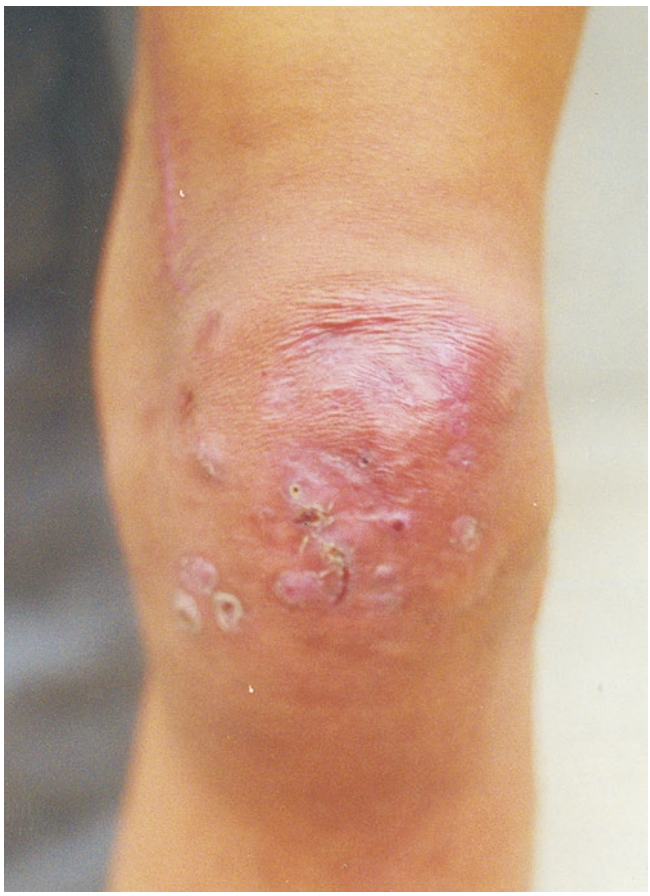


Fig. 3-16-1 Nodules and small sinus on the knee, a surgical cut on the upside of knee

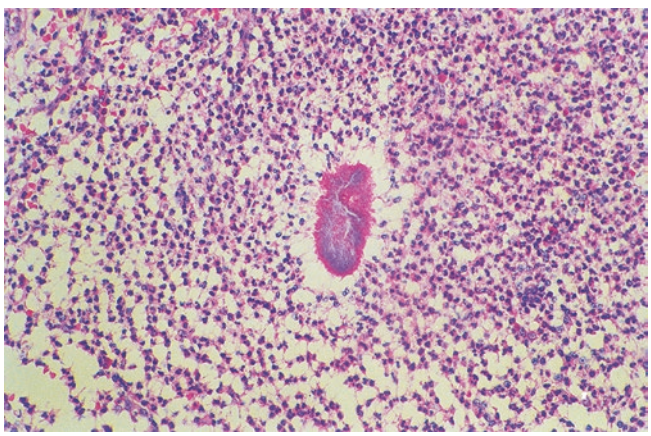


Fig. 3-16-2 Numerous granulomas and inflammatory cells associated with some sulfurate granulas (HE stain, ×200)

3.17 Primary Cutaneous Mucormycosis Caused by *Rhizomucor variabilis* [18]

- Cutaneous mucormycosis usually occurs in individuals with predisposing factors such as diabetes, malignancy, solid organ transplantation, and trauma. Direct inoculation may be the route of transmission.
- *Rhizomucor variabilis*, the main causal agent, is mainly involved in superficial or subcutaneous infections that are more indolent and evolve chronically.
- The clinical features are characterized by erythematous violaceous plaques that show progressive central necrosis, peripheral erythema, and later ulceration, exhibiting the clinical aspect of the so-called bull's eye lesion.
- Early therapy is vital for a good prognosis. The first-line treatment consists of liposomal amphotericin B therapy and surgical resection. Alternatives include posaconazole, hyperbaric oxygen therapy, interferon gamma, and potassium iodide.

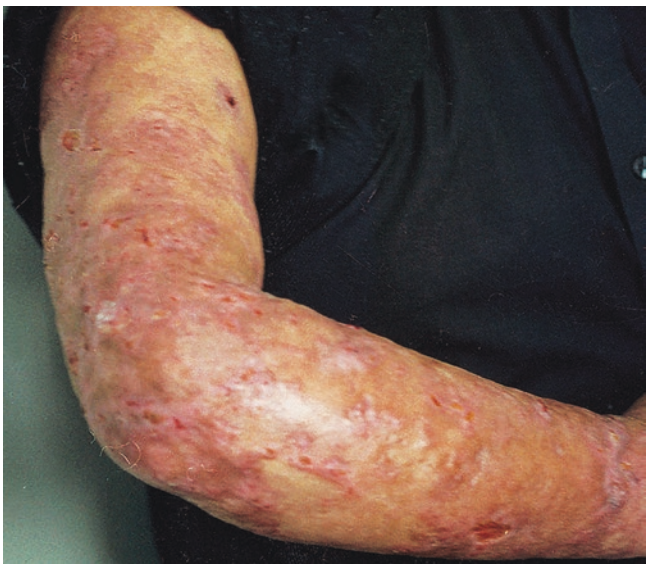


Fig. 3-17-1 Diffused swelling, suppurating plaques, ulcer, and crust on the right arm

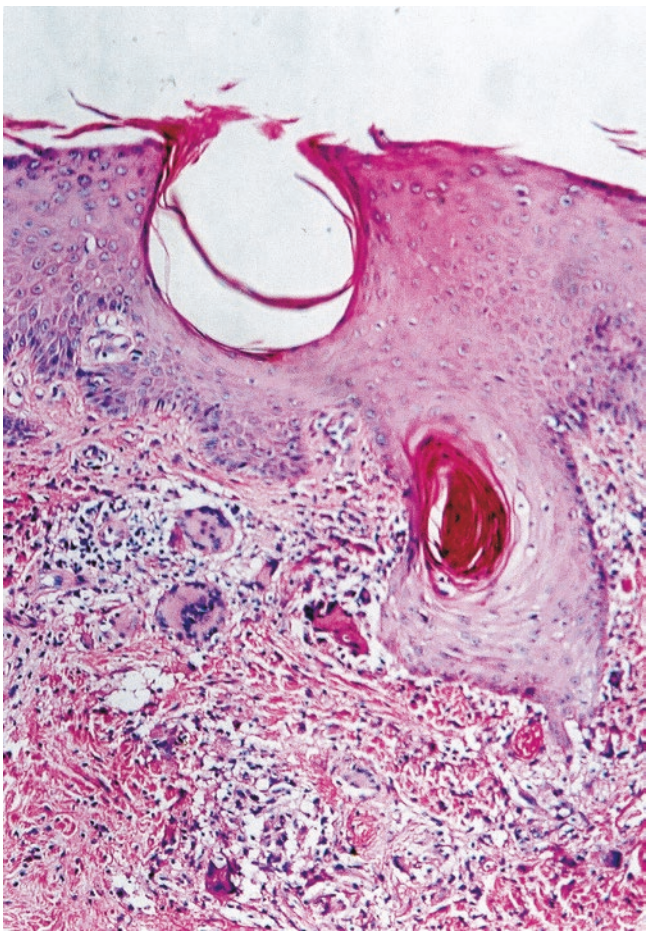


Fig. 3-17-2 Many inflammatory cells and multinucleated giant cells in the dermis (HE stain, ×200)

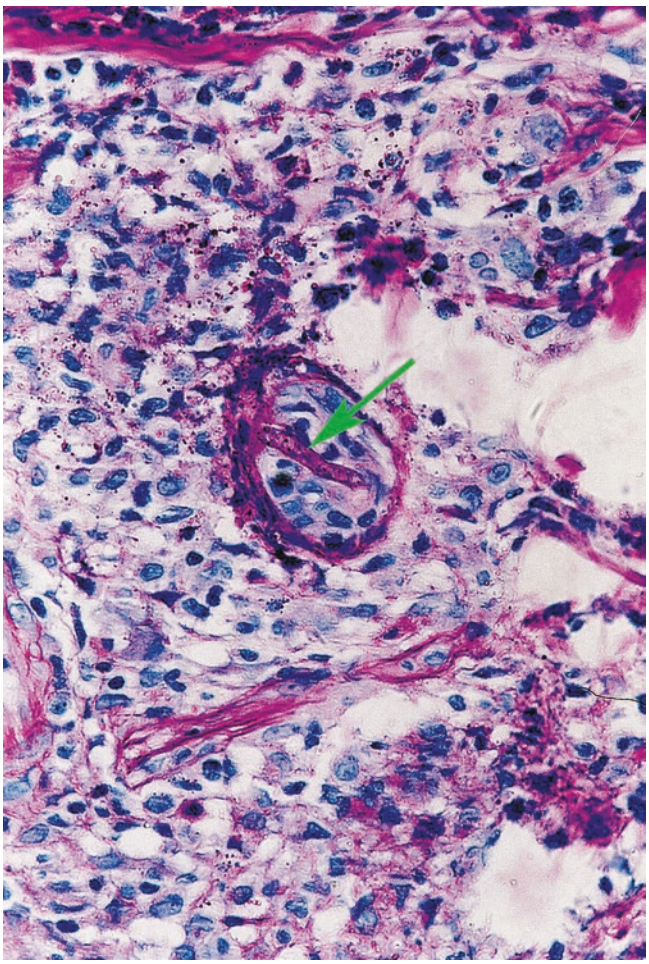
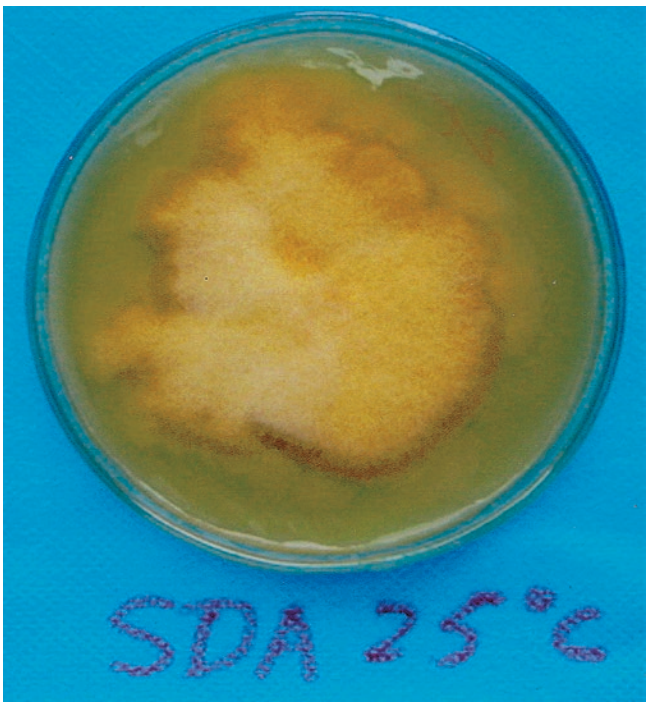
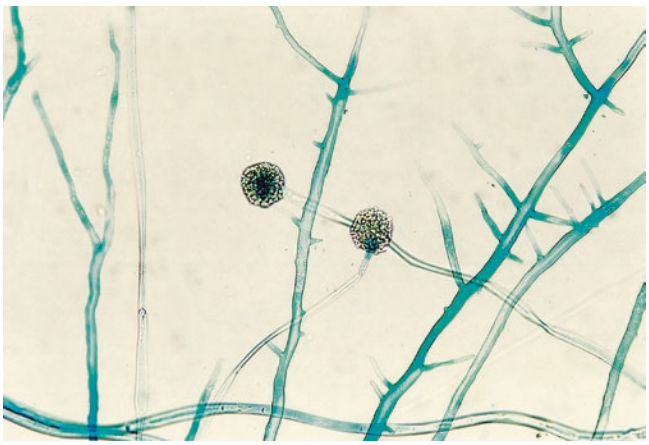


Fig. 3-17-3 A long and wide mycelia (↑), within and around the vessel (PAS stain, ×300)





Figs. 3-17-4, 3-17-5 *Rhizomucor variabilis* colony and macrospore on the medium

3.18 Cutaneous Alternariosis [19]

- Alternariosis is an infection caused by fungi that are generally seen in immunodeficient patients. Cutaneous alternariosis exists in two forms: an epidermal type or a dermal type, depending on the depth of fungal invasion. In both types, the lesion usually appears on exposed sites such as the dorsum of the hands, forearms, knees, and legs. Scaly infiltrated erythematous or ulcerative lesions are observed with the epidermal type. The dermal type has been described as plaques with papules, pustules, and crusts and with a surface that is more or less granular and atrophic.
- There are no clinical trials or guidelines to guide the treatment of this condition; however, itraconazole is the most commonly used antifungal in published cases.

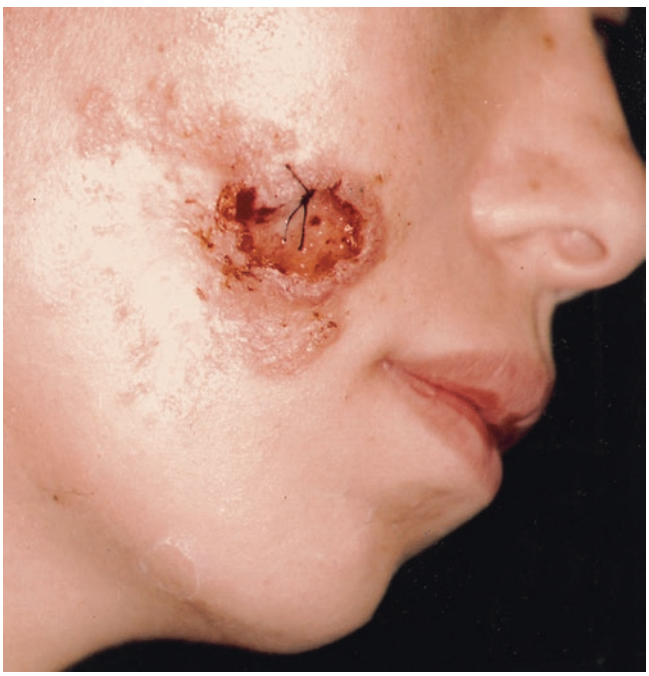


Fig. 3-18-1 Infiltrative plaques on the right cheek with ulceration in the center

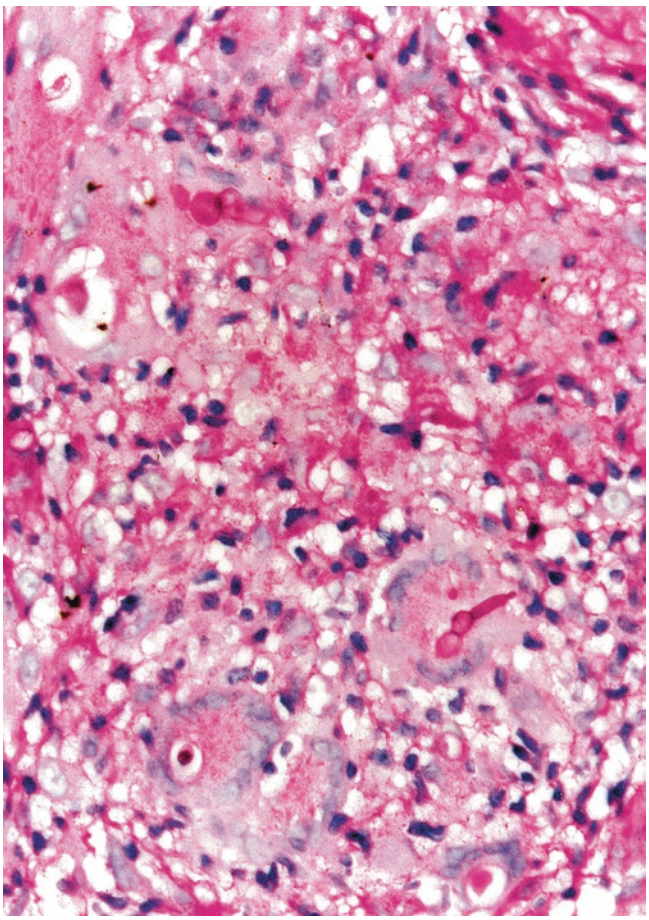


Fig. 3-18-2 Staining revealed irregular septate hyphae and large round spores in the giant cells (PAS stain, ×400)

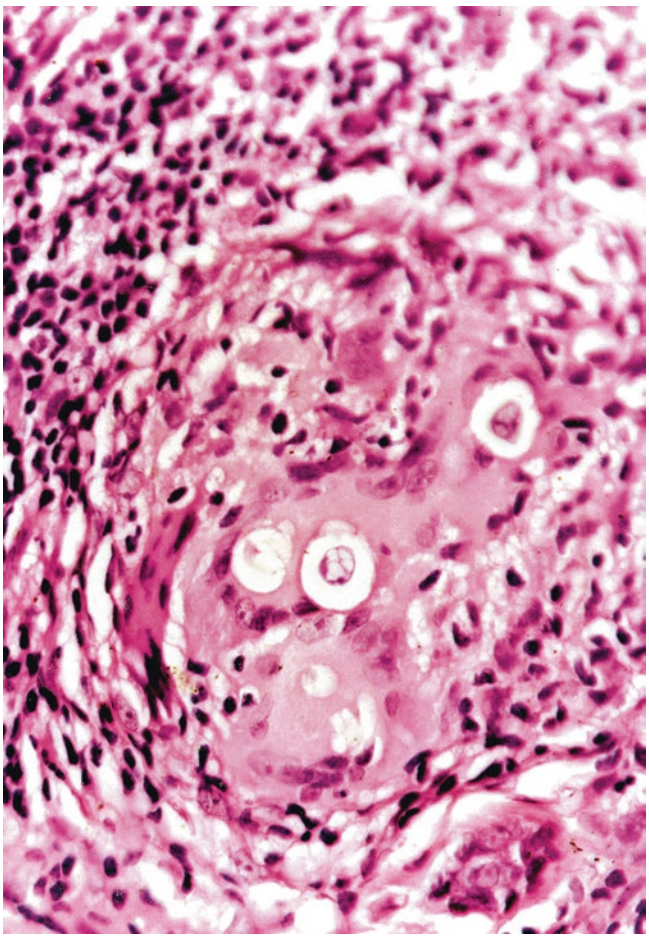


Fig. 3-18-3 Tuberculoid granulomas with numerous giant cells at the margins of ulceration. Vacuole-like structures and brown septate hyphae and brown spores in the giant cells (HE stain, ×400)

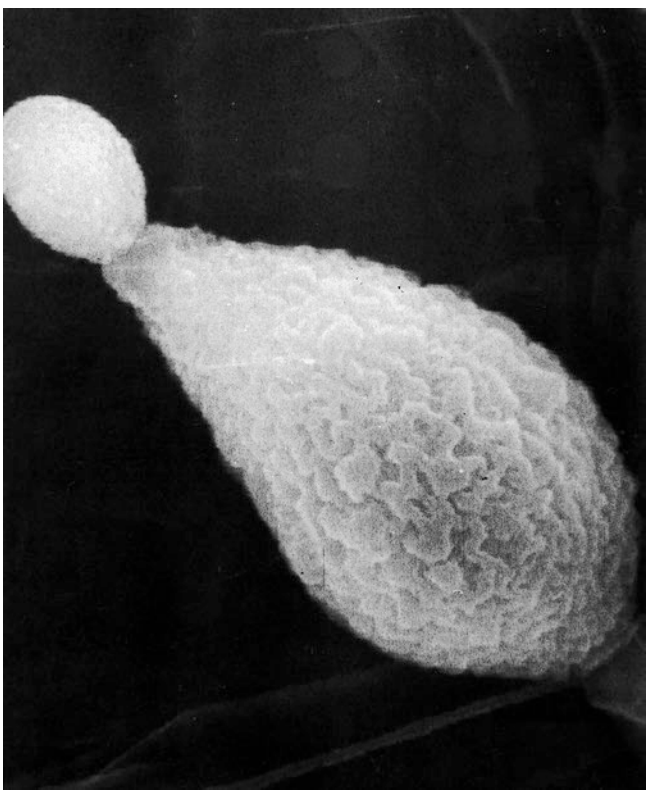


Fig. 3-18-4 Septate hyphae and spores by scanning electron microscopy (×3000)

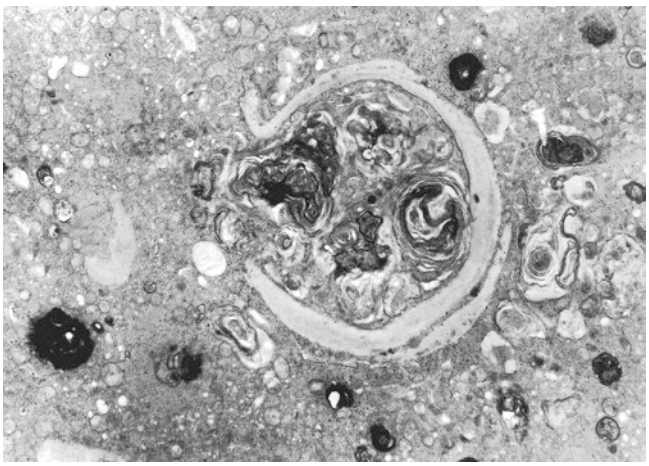


Fig. 3-18-5 Large round spores in the giant cells under transmission electron microscopy (×3000)

3.19 Skin Granuloma Due to Fusarium [20]

- *Fusarium* are opportunistic environmental microorganisms that occasionally result in invasive fusariosis in immunocompromised patients but rarely cause localized infections in immunocompetent individuals.
- The skin lesions can occur at any sites, especially with predominance in the extremities, and they are recognized as nodules, ulcers, mycetoma, and intertrigo.
- Histologically, the lesions consist of necrosis, panniculitis, or granuloma, in which hyaline acute-branching septate hyphae can be seen. The infectious agents invade the dermis and occasionally extend into the blood vessels with thrombosis.

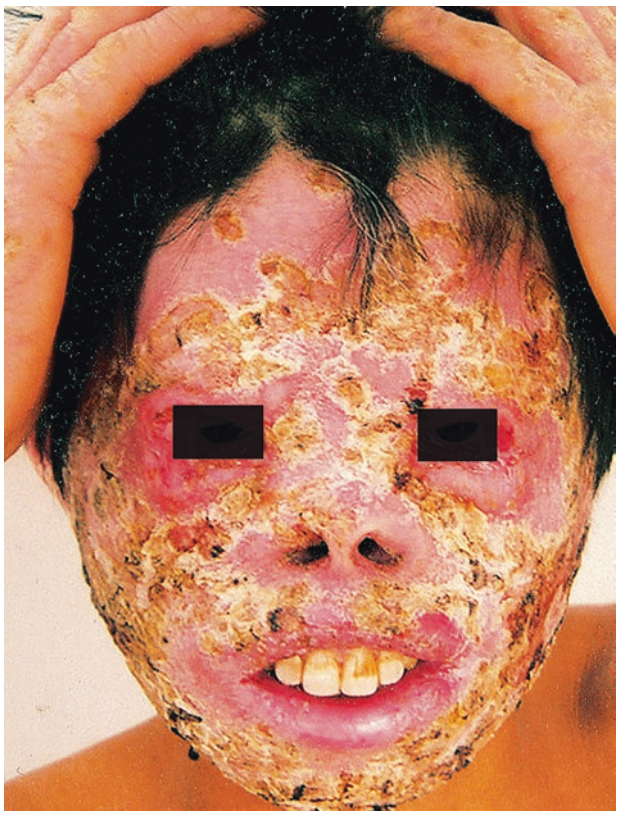
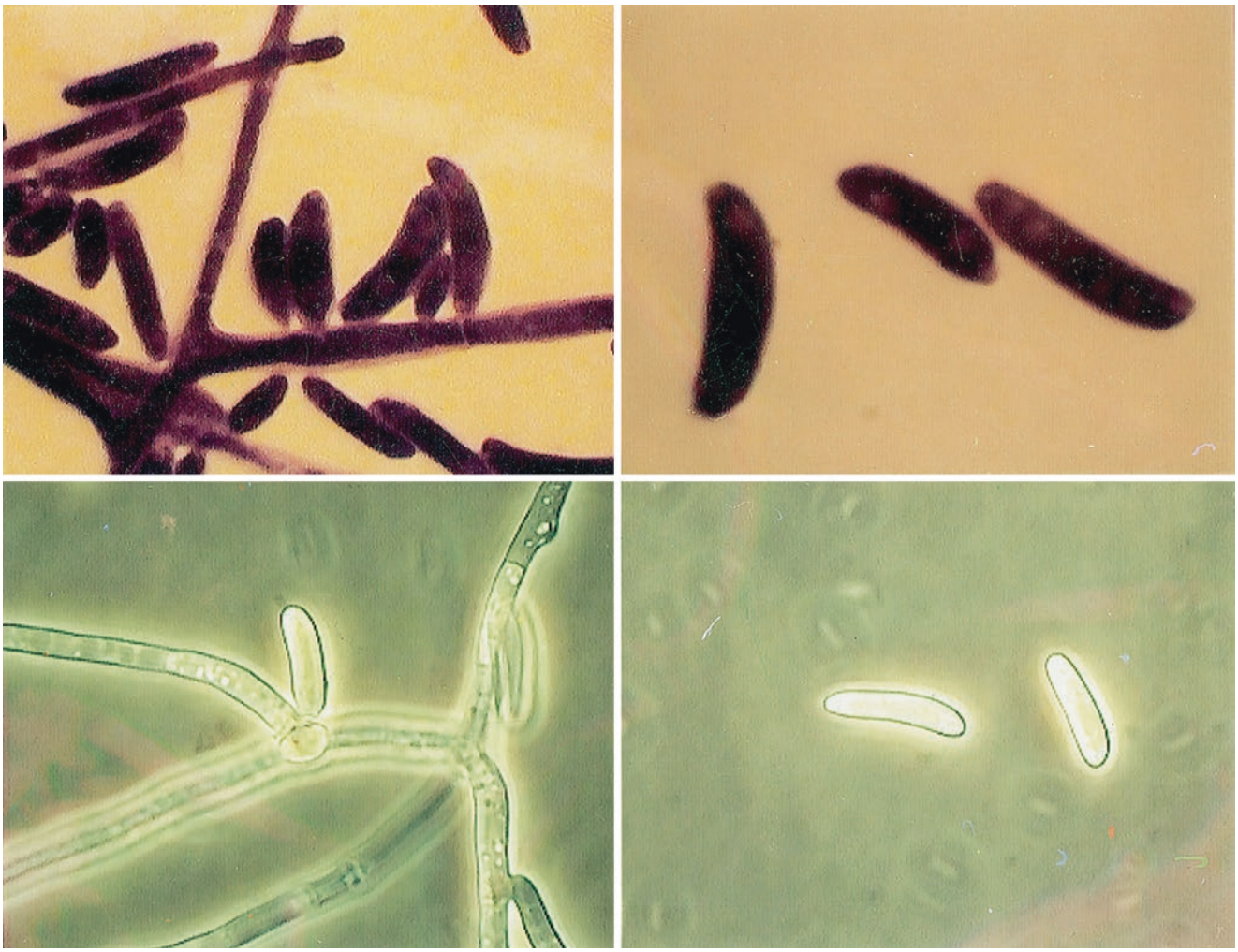


Fig. 3-19-1 A diffuse infiltrated plaque with ulcers, crusts, and scales on the face. Both eyelids, the wing of the nose, and auricle were destroyed or lost, and eyebrows were absent (Reproduced with the permission from [20])



Figs. 3-19-2, 3-19-3 The septate transparent hyphae with branching, oval microspores, and sicklelike macrospores were present (2. Gram stain, ×3680)

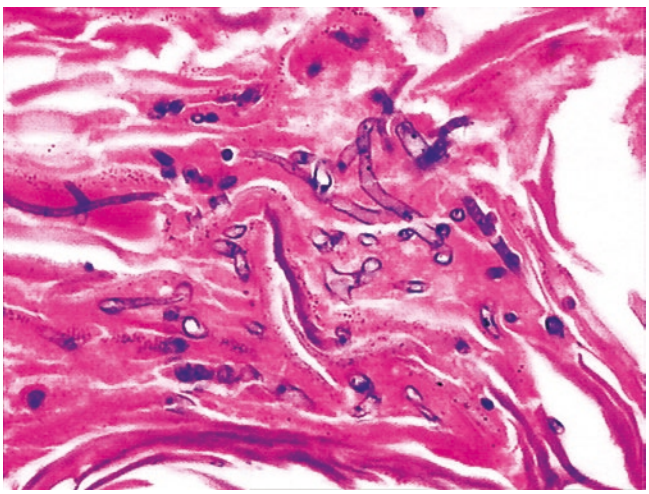


Fig. 3-19-4 Septate hyphae were present in the horny layer (HE stain, ×400)

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