



## Onychomycosis caused by *Fusarium solani* and *Fusarium oxysporum* in São Paulo, Brazil

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### Abstract

*Fusarium* species are common soil saprophytes and plant pathogens that have been frequently reported as etiologic agents of opportunistic infections in humans. We report eight cases of onychomycosis caused by *Fusarium solani* (4) and *Fusarium oxysporum* (4) in São Paulo, Brazil. These species were isolated from toenails in all cases. The infections were initially considered to be caused by dermatophytes. The clinical appearance of the affected toenails was leukonychia or distal subungual hyperkeratosis with yellowish brown coloration. The eight cases reported here suggest that *Fusarium* spp. should be taken into consideration in the differential diagnosis of *tinea unguium*.

**Key words:** *Fusarium solani*, *Fusarium oxysporum*, onychomycosis

### Introduction

Onychomycosis is defined as an infection of nails caused by fungi and represents from 18 to 40% of all onychopathies and 39% of all superficial mycotic infections [1, 2].

Nail mycoses can be caused by three groups of fungi: dermatophytes, yeasts, and non-dermatophytes filamentous fungi. However, there are striking geographic differences in the epidemiology and etiology of onychomycosis, especially in the frequency with which each group of fungi is responsible for infections [3, 4].

The most important non-dermatophyte moulds causing onychomycosis are said to be *Alternaria alternata*, *Aspergillus* spp., *Cephalosporium* spp., *Fusarium* spp., *Natrassia mangiferae* (*Hendersonula toruloidea*) and *Scopulariopsis brevicaulis* [5–7].

*Fusarium* species are common hyaline soil saprophytes and plant pathogens, which have been frequently reported as etiologic agents of opportunistic infections in humans. These infections have usually been limited to superficial mycoses, but recently the number of infections of deep tissues and disseminated infections have greatly increased, especially in pa-

tients with underlying immunosuppressive conditions [8].

Onychomycoses due to *Fusarium* spp. almost always involve the great toenails, especially those affected by traumatic and dystrophic abnormalities, and/or nails already infected by dermatophytes [9, 10].

Close contact with soil, the habit of going barefooted or wearing sandals, or of frequenting swimming pools and trauma are regarded as predisposing factors to development of onychomycosis and intertrigo due to *Fusarium* species [11].

These infections require more attention because of the invasive potential of the *Fusarium* spp., which manifests themselves when host immune responses are impaired [12].

We report our experiences in eight cases of onychomycoses caused by *Fusarium solani* and *F. oxysporum* in São Paulo, Brazil.

### Material and methods

From July 1996 to December 1998, patients with a presumptive diagnosis of onychomycosis were ex-

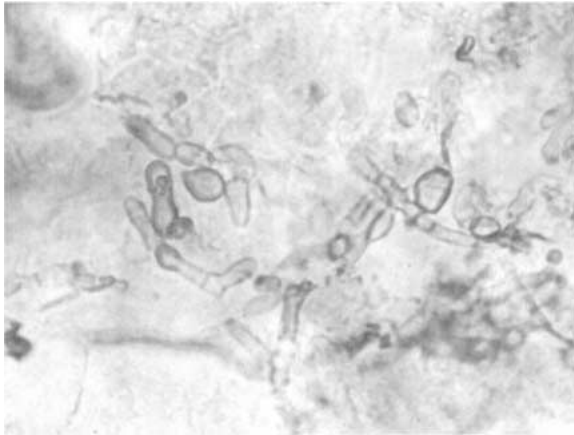


Figure 1. Toenail preparations in 20% KOH plus Parker ink, showing branched, septate, distorted, hyaline hyphae of *Fusarium* spp., which resemble those of the dermatophytes (400×).

amed at the Dermatology and Mycology Divisions EPM/UNIFESP, Brazil.

Samples of nails previously cleaned with 70% alcohol, were collected with a sterilized scalpel. The first layer of scales from distal toenail lesions were discarded to eliminate the presence of contaminating organisms. The other parts of the scales were stained with 20% KOH plus Parker's blue-black permanent ink (3:1), and observed by direct microscopy. Scales were also cultured on Sabouraud-glucose agar (Difco®) with chloramphenicol (200 mg/L), Mycosel® agar (BBL) and lactrimel agar according to Borelli (1972) modified (13) and incubated at 25 °C C for 21 days.

### Case reports

Only eight of a total of 547 patients with a clinical diagnosis of onychomycosis, yielded cultures of *Fusarium* species. The epidemiological and clinical data on these patients are presented in Table 1. Microscopic examinations of skin scales and/or nail scrapings showed hyaline, branched, septate hyphae resembling those of dermatophytes (Figure 1). In case number 5, hyphae were also observed in histopathologic sections of the nails (Figure 2). The presence of the fungi in direct microscopic examinations and in histopathological examinations and the repeated isolation of the same organisms, offers convincing proof that *Fusarium* spp. invade the nails of humans [14].



Figure 2. *Fusarium* spp. observed in histopathologic sections of toenails (Hematoxylin-eosin 400×).

### Mycology

Pure cultures were isolated on Sabouraud-glucose agar (Difco®) with chloramphenicol (200 mg/L) and lactrimel agar.

*Fusarium solani* was identified in cases 1–4. The colonies presented a cream-coloured mycelium with a green to bluish brown reverse. Cultures were examined periodically. *Fusarium solani* was identified through the observation of the macromorphology and the microscopic features of the suspected colonies in microculture. Numerous microconidia on long phialides and the presence of macroconidia with indistinct foot-cells confirmed the diagnosis.

The isolates identified as *F. oxysporum* (cases 5–8) developed white colonies, which gradually become purple with a dark blue or dark purple reverse. Microscopic examinations revealed microconidia on short and often lateral phialides and macroconidia with distinct foot-cells.

From the serial samples collected from the eight positive patients, only *F. solani* or *F. oxysporum* grew on Sabouraud dextrose agar and lactrimel agar.

### Discussion

The incidence of onychomycosis due to dermatophytes and other moulds varies from place to place. The routine incorporation of cycloheximide in mycological media, which inhibits the growth of moulds (non- dermatophytes), may explain the low incidence of these organisms in some reports [15].

The role of *Aspergillus* spp., *Fusarium* spp., *Nattractia mangiferae* and *Scopulariopsis brevicaulis*, as

Table 1. Clinical and epidemiological characteristics of the eight patients infected by *Fusarium solani* or *Fusarium oxysporum*

| Case | Sex    | Age | Race    | Clinical signs                   | Evolution period (year) | Organism            |
|------|--------|-----|---------|----------------------------------|-------------------------|---------------------|
| 1    | Female | 73  | White   | White superficial onychomycosis  | 1                       | <i>F. solani</i>    |
| 2    | Female | 33  | White   | White superficial onychomycosis  | 1                       | <i>F. solani</i>    |
| 3    | Female | 45  | White   | White superficial onychomycosis  | 1                       | <i>F. solani</i>    |
| 4    | Female | 48  | White   | White superficial onychomycosis  | 16                      | <i>F. solani</i>    |
| 5    | Male   | 11  | White   | Distal subungueal hyperkeratosis | 7                       | <i>F. oxysporum</i> |
| 6    | Female | 44  | Black   | Distal subungueal hyperkeratosis | 4                       | <i>F. oxysporum</i> |
| 7    | Female | 58  | White   | Distal subungueal hyperkeratosis | 2                       | <i>F. oxysporum</i> |
| 8    | Female | 59  | Asiatic | Distal subungueal hyperkeratosis | 2                       | <i>F. oxysporum</i> |

a causative agent of onychomycosis is still very much a matter of debate, as they seldom fulfill the accepted criteria for causative pathogens [14, 16].

The genus *Fusarium* comprises a large number of species the majority of them being common soil saprophytes or plant pathogens. The main characteristic of the species is the production of multiseptate, sickle-shaped macroconidia, with a more or less pronounced foot cell (8).

*Fusarium oxysporum* is considered an agent of fingernail and toenail onychomycosis infections [17–19], whereas *F. solani* is more often isolated from toenails [20–22]. These data are not in accordance with Dordain-Bigot et al., who reported the isolation of *F. solani* from fingernails (9). In our study *F. oxysporum* and *F. solani* were isolated only from toenails, four cases each.

We diagnosed leukonychia on toenails caused by *F. solani* in four cases that is in agreement with Zaias [23]. Proximal subungueal onychomycosis with paronychia or distal subungueal onychomycosis have been associated with *F. oxysporum* [24, 25]. We report distal subungueal hyperkeratosis in 4 cases caused by *F. oxysporum* in accordance with the findings to Gianni et al. [25].

Our patients had a normal immune status and were mostly white women between 33 and 73 years of age. Only an 11-year-old male child was found to be infected.

Our cases suggest better attention by laboratory professionals to the correct identification of their fungal isolates before they are discarded as contaminating agents.

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