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Clinical and Onychoscopy Patterns In Fingernail Onychomycosis – A Study By The International Dermoscopy Society "Trichoscopy and Onychoscopy" Task Force

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ABSTRACT

Introduction: Onychomycosis is one of the most common nail diseases. Fingernail onychomycosis is significantly less frequent than toenail onychomycosis and it is often misdiagnosed due to its subtle clinical presentations.

Objectives: We sought to analyze the clinical and onychoscopic features of culture-proven cases of fingernail onychomycosis in adult and pediatric patients.

Methods: Medical records of 120 patients with onychomycosis limited to the fingernails were collected and analyzed across several dermatological centers (Italy, Switzerland, Spain, Greece, Brazil, India, Morocco, Tunisia). Data collected included age, sex, affected hand, affected fingernails, isolated fungal microorganism, clinical, and onychoscopic signs.

Results: A total of 341 fingernails were analyzed. The most commonly affected hand was the right one, and the most frequently affected digits were the second and third. The mean number of affected digits per patient was 2.84. Cultures identified *Trichophyton rubrum* in 54 cases, *T. mentagrophytes* var. *interdigitalis* in 20 cases, *Aspergillus spp.* in 8 cases, *Candida spp.* in 31 cases, and various other fungi in the remaining cases. Major clinical and onychoscopic features observed included onycholysis, subungual hyperkeratosis, leukonychia, chromonychia and absence of the cuticles. On the basis of all findings, 4 main types of fingernail onychomycosis were identified.

Conclusions: Fingernail onychomycosis presents with distinct clinical and onychoscopy characteristics that can overlap with other nail conditions. Dermoscopy enhances diagnostic accuracy, but mycological confirmation is mandatory for a definitive diagnosis.

Introduction

Onychomycosis is one of the most common nail diseases and describes the invasion of the nail by fungi, mainly anthropophilic dermatophytes including *Trichophyton rubrum* and *Trichophyton mentagrophytes* var. *interdigitalis* [1,2]. Yeasts and molds are less frequent culprits and often require rigorous criteria for being acknowledged as the responsible agents [3]. True *Candida* onychomycosis is a rare condition usually affecting immunocompromised individuals. *Candida* is in fact mainly a colonizer, a secondary phenomenon, of other diseases [4] such as chronic paronychia or idiopathic onycholysis [5]. Mixed infections are also a possibility when dealing with onychomycosis [6].

According to the literature, fingernail onychomycosis is 7 times less frequent than toenail onychomycosis [7]. Fingernail onychomycosis is commonly associated with toenail onychomycosis in the "two-feet one-hand syndrome" where the fungi invade both soles and 1 palm and all toenails and the fingernails of 1 hand. When not associated with toenail involvement, onychomycosis of the fingernails is a rare and often misdiagnosed and mistreated condition, especially when limited to 1 or 2 nails. Many nail dystrophies in fact can mimic fingernail onychomycosis, due to the fact that the nail apparatus has a limited repertoire of reaction patterns [8-11]. Also, clinical variants of fingernail onychomycosis have not been described much in detail as for toenail onychomycosis [12]. Different clinical variants usually depend on the way and to the extent to which fungi colonize the nail unit: (a) Distal and lateral subungual onychomycosis (DLSO) where fungi invade the nail through the hyponychium and spread proximally; (b) white superficial onychomycosis (WSO) where fungi colonize the dorsal nail plate, forming white opaque patches; (c) proximal subungual onychomycosis (PSO) where fungi penetrate the nail via the proximal nail fold and localize under the proximal nail plate causing proximal leukonychia and possible acute periungual inflammation; (d) endonyx onychomycosis (EO) where fungi colonize the medial part of the nail plate with sparing of the nail bed; and (e) total dystrophic onychomycosis (TDO) resulting from long-standing DLSO or PSO, and presenting with a diffusely discolored, friable and invaded nail plate [13,14].

Onychomycosis is an important infection to rule out because its management can be challenging, especially due to the slow nail growth, treatment resistance, scarce compliance to treatments, drug to drug interactions, and onset of possible adverse events. For this reason, when onychomycosis is suspected, laboratory confirmation should always be performed. Toenail onychomycosis has been extensively described and clinicians generally know when they are dealing with a mycotic infection, thanks also to the well-known onychoscopy patterns: jagged edge of the proximal margin of the onycholytic area with sharp structures (spikes) directed to the proximal nail fold, white-yellow longitudinal striae within the onycholysed nail plate, parallel bands of varying colors (aurora borealis) and a ruin like appearance of the subungual hyperkeratosis [15-18].

This is less true for onychomycosis limited to the fingernails. In such cases, the literature is scarce, and the subtle

clinical presentation makes diagnosis more challenging than usual, leading to diagnostic delays.

Objectives

The objective of this study was to describe the clinical and onychoscopy features of culture-proven cases of fingernail onychomycosis in adult and pediatric patients.

Methods

Medical records of 120 patients affected with onychomycosis limited to the fingernails were collected and analyzed. All patients and caregivers had agreed to sign a written informed consent for publication of their case details. The ethical principles for human studies as outlined in the Declaration of Helsinki were followed and attested. The study spanned across several dermatological centers (Italy, Switzerland, Spain, Greece, Brazil, India, Morocco, Tunisia), each researcher contributing anonymized patient data to the collective analysis. Inclusion criteria comprised male and female patients, adults and children, diagnosed with isolated fingernail onychomycosis (no other nail dystrophy or disease associated), not on any treatment at the time of the diagnosis for the previous 6 months. The 6-month timeframe was selected according to the nail plate growth rate (3 mm/month for fingernails and 1.5 mm/month for toenails), ensuring adequate nail plate regeneration not influenced by treatment for a correct diagnosis. Each patient had their diagnosis confirmed by direct microscopy with 40% potassium hydroxide and culture. Exclusion criterion was the involvement of toenails with onychomycosis and other diseases affecting the nails. Data collected included age, sex, affected hand, affected fingernails, fungal microorganism isolated, clinical and onychoscopy signs. Data about a correlation between the localization of the infection and the dominant hand were, unfortunately, not collected. Clinical and onychoscopy pictures (magnification 10X), available for each case, were independently analyzed by each author. Statistical analysis was performed with IBM SPSS Statistics (Version 25.0: IBM Corp., 2017).

Results

Records of 120 patients (56 males and 64 females) with a mean age of 52 years (range 4 – 92) were analyzed for this study. Only 6 patients were younger than 18 years old, 3 males and 3 females, aged between 4 and 9 years. Fifty-three patients (44.2%) reported the infection on the right hand only, 37 patients (30.8%) on the left hand only and in 30 cases (25%) the infection was bilateral. A total of 341 fingernails were affected in our cohort. The mean number of affected digits per patient was 2.84 (range 1 – 10). The most common affected digits were the second and the third followed by the fourth and the first. The fifth digit was the less frequently affected. Culture revealed 54 cases of *Trichophyton rubrum* infection, 20 cases of *T. mentagrophytes* var. *interdigitalis*, 1 case of *T. verrucosum,* 8 cases of *Aspergillus* spp (7 var. *flavus* and 1 var. *niger*), 2 cases of *Alternaria*, 1 case of *Trichosporon,* 1 case of *Cladosporium*, 1 case of *Geotrichum*, 1 case of *Yarrowia lipolytica* and 31 cases of *Candida* spp. Clinical and onychoscopy features detected on the nail plate, nail bed and periungual area are reported in Table 1. Each digit showed more than one sign and a single sign was not necessarily present in all fingers of a single patient.

Regarding nail plate abnormalities, we observed Beau lines/onychomadesis, pitting, trachyonychia, crumbling, leukonychia in different patterns, melanonychia, and chromonychia (colors other than brown and white, mainly yellow and orange). Regarding nail bed abnormalities, we observed onycholysis, subungual hyperkeratosis and splinter hemorrhages. Regarding nail fold abnormalities we observed paronychia, absence of the cuticles and periungual scaling. Onychoscopy allowed us to better characterize some clinical aspects. Subungual hyperkeratosis, for example, was always minimal and

Table 1. Clinical (C) and Onychoscopy (O) Signs Detected in Our Cohort of 120 Patients.

Nail Matrix/Plate Abnormalities	N (%) of Patients Presenting With This Sign
Beau lines / onychomadesis (C)	23 (19.2%)
Pitting (C) (O)	9 (7.5%)
Trachyonychia (C)	19 (15.8%)
Crumbling (C)	25 (20.8%)
Leukonychia	
• Transverse (C)	32 (26.7%)
• Longitudinal (C)	18 (15%)
• Irregular spots (including punctate) (C)	49 (40.8%)
• Total (C)	5 (4.2%)
Melanonychia (C) (O)	17 (14.2%)
Chromonychia (C) (O)	58 (48.3%)
Nail bed abnormalities	
Onycholysis	
• Linear (O)	48 (49.5%)
• Jagged (O)	49 (50.5%)
Subungual hyperkeratosis (C) (O)	90 (75%)
Splinter hemorrhages (O)	20 (16.6%)
Nail folds abnormalities	
Periungual scaling (C) (O)	27 (22.5%)
Absence of cuticles (C)	59 (49.2%)
Paronychia (C)	38 (31.6%)

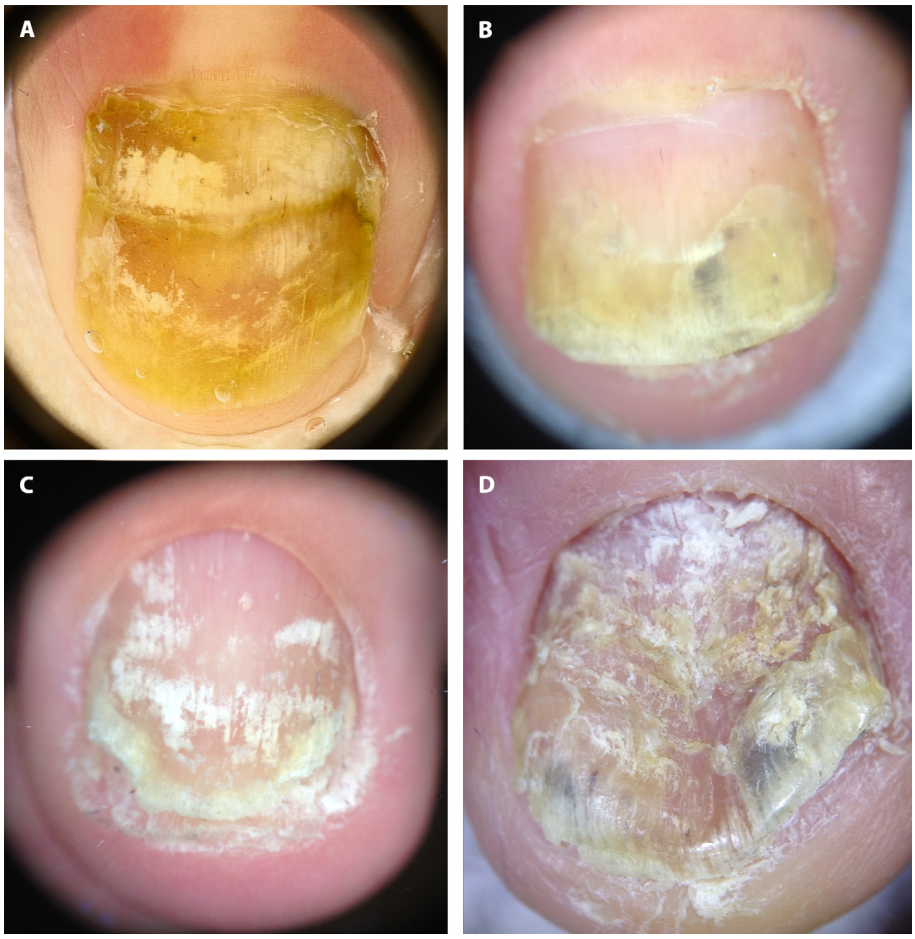

Figure 1. (A) Chaotic type. (B) Subungual hyperkeratosis type. (C) Superficial alteration type. (D) Crumbling type (×10 magnification).

edges of onycholysis were partly linear as well as jagged with spikes. Onychoscopy allowed us also to better identify the hemorrhages and presence of melanonychia and chromonychia.

On the basis of these findings, we could identify 4 main types of fingernail onychomycosis which are best described as follows:

1. Chaotic type (Figure 1A) (35/120 – 29.2%) - color changes are the predominant onychoscopic feature in this type. It is characterized by a combination of multiple features including leukonychia (transverse or irregular spots) with spiked pattern, chromonychia (green, brown, black), onycholysis and paronychia. This type can be associated with distal subungual onychomycosis (DSO) or proximal subungual onychomycosis (PSO).
2. Subungual hyperkeratosis type (Figure 1B) (49/120 – 40.8%) - onycholysis is the onychoscopic predominant feature in this type. It is characterized by moderate to severe onycholysis with minimal jagged margins, subungual hyperkeratosis with minimal ruin aspect, xanthonychia, spots of leukonychia, and nail bed hemorrhages. This type can be associated with DSO and DLSO invasion.
3. Superficial alterations type (Figure 1C) (11/120 – 9.2%) - nail plate surface changes are the predominant onychoscopic feature in this type. It is characterized by pitting or trachyonychia, irregular spots of leukonychia, minimal onycholysis, minimal subungual hyperkeratosis, absence of the cuticle and periungual scaling. These findings can be associated with WSO and EO.
4. Crumbling type (Figure 1D) (25/120 – 20.8%) - destruction of the nail plate is the predominant onychoscopic feature in this type. It is characterized by nail plate crumbling, chromonychia, spots of leukonychia, nail bed hemorrhages and absence of the cuticle. These findings can be associated with TDO.

The association between types of fingernail onychomycosis and etiological fungal species were not statistically significant. However, the association between the fungal genera and few clinical and onychoscopic signs were found to be statistically significant: Beau lines/onychomadesis (P = 0.02) and paronychia (P = 0.02) were more frequently observed in cases of infection by yeasts (*Candida, Yarrowia* and *Trichosporon*). Total leukonychia (P = 0.03), melanonychia (P = 0.04) and periungual

scaling (P = 0.002) were more frequently observed in cases of infection by molds (*Aspergillus, Alternaria* and *Cladosporum*). Finally, subungual hyperkeratosis (P = 0.03) and leukonychia with irregular spots (P = 0.01) were more frequently observed in cases of infection by dermatophytes (*Trichophyton spp*). Also, trachyonychia was more frequent in older (P = 0.02) and female (P = 0.04) patients, while pitting was more common in younger patients (p=0.01) and subungual hyperkeratosis in men (P < 0.001). No statistically significant association was found between any fungal agent and the number of digits affected, nor with the involvement of one or both hands.

Conclusions

Fingernail onychomycosis is an uncommon nail condition, especially when it presents as an isolated form and not associated with toenail onychomycosis. Its subtle clinical presentations may be sometimes atypical, often delaying diagnosis.

While toenail onychomycosis, especially DLSO, typically presents with jagged margin of the onycholytic border, yellow discoloration with spikes, and yellowish subungual hyperkeratosis possibly with a ruin like aspect [16-18], its counterpart in fingernails present with a less obvious picture that is more often characterized by minimal nail bed hyperkeratosis, severe onycholysis, dystrophic nail plate and paronychia.

Fingernails are constitutionally thinner than toenails and hands experience different degrees of trauma as compared to the feet. Fingernails are also much more in contact with water and detergents, explaining why onycholysis is more severe and subungual keratosis minimal in fingernail onychomycosis. It is also possible that subungual hyperkeratosis is periodically removed by patients with a sharp file, which in turn, promotes a mechanical worsening of the onycholysis. This is a procedure usually performed by females and this may explain why subungual hyperkeratosis was mostly found in males in our study. According to literature, linear onycholysis is typical of traumatic or idiopathic onycholysis [16-19]. As stated, we found it in a significant number of our cases, but it is unclear whether it started as such or if it occurred later due to frequent cleaning of the subungual space and contact with water and detergents. Of note, the number of cases presenting with linear onycholysis in our series mostly occurred in females (56.2%).

Nail plate surface abnormalities of different degree and type were another common sign of fingernail onychomycosis in our study. Superficial alterations are instead not typical of toenail onychomycosis. Kayarkatte et al [17] also described surface abnormalities introducing the term "lamellar microsplitting" for irregularly placed fine transverse splitting of the nail plate surface, best visualized with nonpolarized dermoscopy. We did not observe this sign in our patients, where crumbling and Beau line/onychomadesis were instead the most prevalent nail plate surface alterations (20.8% and 19.2% respectively). Beau lines/onychomadesis were more frequently observed in cases with infection by yeasts (*Candida*, *Yarrowia* and *Trichosporon*). Ramos-Pinheiro et al [19] described, as we did, the crumbling pattern with distal breakage, crumbling of the nail edge and subungual hyperkeratosis in 13.6% of cases. Apart from this paper, our study is the first to focus on such a feature in onychomycosis. It is to be noted that crumbling of the nail plate may also be a sign of severe psoriasis [20]. Psoriasis is the disease that mostly goes in differential diagnosis with onychomycosis, besides the fact that the two diseases can coexist. According to recent reviews on onychoscopy of nail psoriasis, pitting, crumbling, leukonychia, onycholysis with minimal subungual hyperkeratosis, and periungual scaling are signs in common with the two diseases [21,22]. Psoriasis is however an inflammatory condition usually involving more than one digit even if a single digit psoriasis should always be considered in differential diagnosis.

The presentation of fingernail onychomycosis with chromonychia and periungual inflammation may mimic chronic paronychia and bacterial infection. Leukonychia (white discoloration) seems however to be the prevalent color in fingernail onychomycosis, while it is less frequently described in toenail onychomycosis, where yellow and brown are the most prevalent colors seen [16,23]. In our study total leukonychia was more frequently observed in cases of infection by molds (*Aspergillus, Alternaria* and *Cladosporum*) similarly to what is observed in toenail onychomycosis. The other clinical presentations of leukonychia had a different prevalence in each type of fingernail onychomycosis, possibly related to different modalities of fungal invasion. Leukonychia could be due to fungal colonies above (WSO) or within the nail plate (EO) and it might be also related to matrix inflammation as in PSO or TDO. Trauma usually play an important role in the development of true leukonychia (any form) and fungal invasion can be considered a significant cause of trauma [24]. A clipping of the part of nail plate showing leukonychia followed by PAS stain would be beneficial to better characterize this sign in presence of an onychomycosis. Larger prospective studies involving patients with fingernail onychomycosis could help confirm this finding.

We could not collect data about the dominant hand of the patients; hence, a correlation between the localization of the infection and the dominant hand or about a specific trauma could not be made. It would be useful to collect this data in future studies to better evaluate any potential relationship between trauma and single digit onychomychosis [11].

Onychoscopy, though it has proven to be a reliable tool for a definitive diagnosis of toenail onychomycosis, is not that reliable in fingernail onychomycosis. According to the literature, fingernail onychomycosis is a rare variant of onychomycosis that usually affects immunocompromised patients [4,25].

In our experience patients can be affected by fingernail onychomycosis even without a history of immunosuppression. None of the 120 patients involved in this study was, in fact, immunocompromised. Moreover *Candida* spp. is usually the pathogen isolated in fingernail onychomycosis, but our study demonstrates how dermatophytes can be even a more frequent cause and, for this reason, we highly suggest searching for all possible pathogens with culture examination or PCR [26,27].

Our study shows that there are no clinical or onychoscopy features diagnostic for fingernail onychomycosis and differentiation with more common fingernail conditions only relies on mycological study.

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