

# The Prevalence of Fungi in Fingernail Onychomycosis

PRAKASH GELOTAR, SWATI VACHHANI, BHARGAV PATEL, NARESH MAKWANA

## ABSTRACT

**Background:** Fingernail onychomycosis is a fungal infection of the finger nails. It is mainly produced by yeasts, dermatophytes and molds and sometimes it shows a mixed infection. It is a cosmetic issue rather than a medical problem.

**Aims:** This study was conducted with the aim of exposing the fungal concept in nail diseases, to introduce nail testing which was underutilized as a diagnostic tool despite being involved in many dermatological conditions, as well as to introduce microbiological techniques in the diagnosis of nail diseases, based on the clinical parameters only.

**Materials and Methods:** A total of 45 samples were tested in our laboratory by using 20% KOH and culture plates of Sabouraud's Dextrose Agar (SDA) which were mixed with chloramphenicol and cycloheximide.

**Results:** A total of 37.78% samples were identified as positive by culture, among which 17.78% were KOH positive and 20.00% were KOH negative. 62.22% were culture negative. The predominant pathogen was yeast (64.71%), followed by dermatophytes (17.65%). A mixed infection was identified in 11.76%. *Scytalidium hyalinum* was identified in 5.88% of the cases. Fungi commonly presented in the middle age, between 31-40 years of age, due to trauma at the work site and in women, due to their wet work.

**Conclusion:** This study highlighted the yeast, genus *Candida* as the main pathogen which caused fingernail onychomycosis in our region. So, it is imperative to diagnose it properly by using microbiological techniques and to treat it properly.

**Key Words:** Yeasts, Dermatophytes, Mixed infection, Middle age, Wet work, *Candida* yeast

## INTRODUCTION

Onychomycosis (Greek word Onyx=nail+ Mykes =fungus) is traditionally defined as a fungal infection of the nail [1,2]. For some patients, nail disease is a cosmetic issue rather than a medical problem and they seek advice for cosmetic reasons. However, it can cause pain, social, emotional and occupational discomfort, permanent damage to the nail for the patient and spread of the infection to other persons [3]. It may need a long term treatment. Onychomycosis cover 50% of the nail infections [4,5]. Onychomycosis is classified into several types like Distal Subungal Onychomycosis (DSO), White Superficial Onychomycosis (WSO), Proximal Subungal Onychomycosis (PSO) and Total Dystrophic Onychomycosis (TDO) [6].

There is a long list of fungi which have a tendency to damage the nail, like dermatophytes (50%), yeasts (27%) and molds (23%) [7]. However, all the nail diseases are not fungal in origin they are also caused by other clinical conditions [6] like trauma, wet work (with the hand submerged in water) [8], HIV-AIDS [6], immunodeficiency which is due to organ or bone marrow transplantation [6], old age, psoriasis, atopic dermatitis [9], diabetes with a predominance of *Candida* spp [10], renal transplant recipients [11], etc. The Dermatophytes spp. are mostly distributed in the temperate western countries. The *Candida* spp.(yeasts) are mostly distributed in the tropical and the subtropical countries and in the persons whose hands are often submerged in water [12]. The common fungi from the Dermatophytes category are *Trichophyton rubrum*, *Trichophyton mentagrophytes* and *Epidermophyton floccosum* and the yeasts include *Candida albicans*, *Candida*

*parapsilosis*, *Candida tropicalis*, etc, while the molds include a wide range of fungi like *Scytalidium* spp., *Aspergillus* spp., *Geotrichum candidum* and *Fusarium* spp. *Scytalidium* is present in tropical regions [12]. *Scytalidium* is a saprophytic fungus which is present in water, soil, plants and some decaying material and it is transmitted by direct contact [13]. Dermatophytes and yeasts are present mainly in the middle age. The molds mainly affect older persons who are over 60 years of age [13]. The Dermatophytes are common in men in foot nail onychomycosis because of the constant wearing of shoes, perspiration and exercise. The yeasts are common in women in fingernail onychomycosis because their hands are often submerged in water.

Due to the increase in the incidence of onychomycosis in the past few decades and also due to the involvement of climate, occupation, socio-economic status, gender, age and genetic and immune factors, it is necessary to determine the fungal agents and their prevalence.

## MATERIALS AND METHODS

A total of 53 samples from fingernail infection patients were obtained in the Department of Microbiology from July 2011 to December 2011. At the time of taking the samples, after making a careful inquiry into the medication, the samples of those who took antifungal treatment were not included in the present study. So, 8 samples were excluded and 45 samples were tested over a period in the Microbiology Department, M.P. Shah Medical College, Jamnagar, Gujarat. Oral informed consents were taken from all the participants of the study.

## THE SAMPLE COLLECTION

The nails of the subjects were made sterile by applying spirit (70% ethyl alcohol) to them before the sample collection, to avoid bacterial contamination. Then, the finger nail clippings/scrapings/fragments were collected in a black envelope and they were sent to the laboratory for testing.

## THE TESTING METHODS

All the samples were tested in the following order.

**Step 1:** Direct microscopy, by using freshly prepared 20% KOH to identify the yeast cells, the budding yeast cells, the pseudohyphae, the hyphae and the arthroconidia.

**Step 2:** The culture was done in 2 plates of Sabouraud's Dextrose Agar (SDA) with antibiotics (chloramphenicol and cycloheximide). One plate was incubated at room temperature (25°C- 28°C) for the growth of mycelia and the other was incubated at 37°C for the growth of yeast. Each plate was examined every 3rd day, for a period of three weeks, before they were declared negative.

**Step 3:** All the culture growths were identified on the basis of the culture characteristics, the Lactophenol Cotton Blue (LCB) test, the germ tube test, the Dalmau method by using corn meal agar, the sugar assimilation test and the urease test. The germ tube and the sugar assimilation tests were used to differentiate the *Candida* spp, while the urease test was used to differentiate *T. mentagrophytes* from *T. rubrum*.

## RESULTS

A total of 45 samples were tested in the Microbiology Laboratory. 17 samples (37.78%) were identified as positive by culture, among which 8 samples (17.78%) were found to be KOH positive and 9 samples (20%) were found to be KOH negative. 28 samples (62.22%) were identified as negative by both the methods, as has been shown in [Table/Fig-1].

[Table/Fig-2] presents the fungi which were identified from various samples. The predominant pathogen which was identified in our study was *C. albicans* in 52.94% of the culture positive samples, which was followed by equal numbers of samples with *C. parapsilosis* (2 cases, 11.77%) and *T. rubrum* (2 cases, 11.77%). In 2 cases i.e. 11.76%, a mixture of dermatophytes and yeasts was

Test	KOH + ve		KOH-ve		Total	
	No	%	No	%	No	%
Culture +ve	08	17.78	09	20.0	17	37.78
Culture -ve	00	0.0	28	62.22	28	62.22
<b>Total</b>	<b>08</b>	<b>17.78</b>	<b>37</b>	<b>82.22</b>	<b>45</b>	<b>100</b>

[Table/Fig-1]: Testing method and result

Category	Fungal spp.	Numbers	Percentage (N=17)
Yeasts	<i>C. albicans</i>	09	52.94
	<i>C. parapsilosis</i>	02	11.77
Dermatophytes	<i>T. rubrum</i>	02	11.77
	<i>T. mentagrophytes</i>	01	5.88
Molds	<i>S. hyalinum</i>	01	5.88
Mixed	<i>C. albicans</i> + <i>T. Rubrum</i>	01	5.88
	<i>C. albicans</i> + <i>T. mentagrophytes</i>	01	5.88

[Table/Fig-2]: Distribution of fungus

Age	Male		Female		Total	
	No	%	No	%	No	%
11-20	0	0.00	01	2.22	01	2.22
21-30	1	2.22	11	24.45	12	26.67
31-40	4	8.89	15	33.33	19	42.22
41-50	4	8.89	08	17.78	12	26.67
>50	0	0.00	01	2.22	01	2.22
<b>Total</b>	<b>9</b>	<b>20.00</b>	<b>36</b>	<b>80.00</b>	<b>45</b>	<b>100.00</b>

[Table/Fig-3]: Distribution of patients according to age group and gender

Predisposing factors	Culture Positive	Culture Negative	Total (N=45)	Chi-square/ Fisher's exact value	p value
Diabetes	2	2	4	0.000144	0.9904
Traumatic injury	12	8	20	5.957	0.0147
HIV/AIDS	2	1	3	0.204	0.6513
skin diseases	3	1	4	1.142	0.2853
Hand submerged in water	14	11	25	6.297	0.0121

[Table/Fig-4]: Predisposing factors associated with fingernail onychomycosis

noticed. Among the remaining cases, 1 case (5.88%) of *T. mentagrophytes* and 1 case (5.88%) of *S. hyalinum* were observed.

[Table/Fig-3] represents the different age groups and the gender which were involved in this study. In the current study, women (80%) were involved more than men (20%). The mean age of the patients was 36.42 years. Most numbers of patients (42.22%) were between 31-40 years of age, followed by an even distribution between the age groups of 21-30 years (26.67%) and 41-50 years (26.67%). 1 case (2.22%) of a teenage girl and 1 case (2.22%) of an older woman were noticed in our study.

[Table/Fig-4] shows the various predisposing factors which were associated with fingernail onychomycosis. Mainly, traumatic injuries and hands submerged in water were the two factors which were found to be more among the culture proven samples for fingernail onychomycosis. A statistical association was also observed in both these factors ( $p < 0.05$ ). Diabetes was equally found in the culture positive and the negative samples. HIV/AIDS and skin diseases were found to be higher among the culture positive samples, but the statistical tests failed to prove this association ( $p > 0.05$ ).

## DISCUSSION

The current study highlighted that if the diagnosis of onychomycosis would rely only on the clinical pattern of the nail changes, we would miss about 37.78% of the fungal causes. In the present study, 20% samples were identified as false negative (KOH negative and culture positive). False negative findings had also been observed in previous reports [5,7,14].

In our study, finger nail onychomycosis was found to be more common in the middle age, between the ages of 31 and 40 years (42.22%) because of repeated traumatic injuries at work sites like in farms or in metal industries. It is rare in older persons and it is least in children. These findings were in accordance with those of other studies [4,5]. Some non-dermatophytic molds like *Scytalidium* spp. are common in older age [13], maybe due to a low immunity, a poor peripheral circulation, a poor personal care and

the presence of some systemic diseases like diabetes. Similar findings were observed in our study. One case (5.88%) of *Scytalidium hyalinum* was observed in a female who was 60 years of age.

A higher rate was noticed in women (80%) than in men (20%), which showed that finger nail onychomycosis was a disease of women. Women are affected because of the constant submerging of their hands in water (among housewives and chorus workers). The same results were obtained by other authors [8,15-19].

Dermatophytes are the most encountered organisms in onychomycosis [3,11]. They cause 90% toe nail and 50% finger nail onychomycosis [2]. However, some studies show equal incidences between dermatophytes and yeasts [14]. Now-a-days, the onychomycosis which is caused by yeasts is increasing, especially in the fingernails [11, 16-19]. These are similar to the observations of our study. In our study, the predominant pathogen was yeast (64.71%), which included 52.94% cases with *C. albicans* and 11.77% cases with *C. parapsilosis*. This was due to the repeated contact with water, which is the common mode of transmission of *Candida* spp. Dermatophytes were present in 17.65% cases, which included 11.77% cases with *T. rubrum* and 5.88% cases with *T. mentagrophytes*. A mixed infection (11.77%) of yeasts and dermatophytes was also observed. The same matter was reported by previous authors [15,18].

## CONCLUSIONS

The present study highlighted that the yeast, genus *Candida* was a predominant pathogen in our region. This provided useful guidelines for the appropriate management of the cases. A high frequency of fingernail onychomycosis was observed among women and so, they were advised to improve their health and personal hygiene. This study suggests that the diagnosis of nail diseases can't rely only on the clinical patterns of the nail changes. It also requires a microbiological confirmation.

## REFERENCES

- [1] Chander J. Textbook of Medical Mycology, Third Edition, New Delhi, Mehta Publishers. 2010 ;132.
- [2] Kaur R, Kashyap B, Bhalla P. Onychomycosis- Epidemiology, Diagnosis, Management. *Indian Journal of Medical Microbiology*. 2008;26(2):108-16.

- [3] Elewski BE. Onychomycosis - Pathogenesis, Diagnosis and Management. *Clinical Microbiology Reviews*. 1998 ;415-29.
- [4] Madhuri JT. Onychomycosis: A significant medical problem. *Indian J Dermatol Venereol Leprol*. 2002;68:326-27.
- [5] Veer P, Patwardhan NS, Damle AS. Study of Onychomycosis: Prevaling fungi and pattern of infection. *Indian Journal of Medical Microbiology*. 2007;25(1):53-56.
- [6] Torres-Rodriguez, JM, Lopez-Jodra O. Epidemiology of nail infection due to keratinophilic fungi. *Rev. Iberoam. Micol*. 17; 2000:122-35.
- [7] Das NK, Ghosh P, Das S, Bhattacharya S, Dutta RN, Sengupta SR. A study on the etiological agent and clinico-mycological correlation of fingernail onychomycosis in eastern India. *Indian J Dermatol*. 2008;53:75-79.
- [8] Neupane S, Pokhrel DB, Pokhrel BM. Onychomycosis: A clinico-epidemiological study, *Nepal Med Coll J*. 2009; 11(2):92-95.
- [9] Sigurgeirsson B, Steingrimsdottir O. Risk Factors associated with Onychomycosis. *JEADV*. 2004;18:48-51.
- [10] Qureshi N. Studying and Diagnosing the Main Causative Agent of Onychomycosis through Laboratory Procedures. *International Journal of Multidisciplinary Sciences and Engineering*. 2012;3(2):13-15.
- [11] Szeptietowski JC. Selected clinical aspects of onychomycosis. *Mikol. Lek*. 2004; 11(2):119-28.
- [12] Onychomycosis, From Wikipedia, free encyclopaedia. Accessed from <http://en.wikipedia.org/wiki/Onychomycosis>.
- [13] Cursi, Igor Brum et al. Onychomycosis by *Scytalidium* spp.: Clinical and epidemiological in a university hospital in Rio de Janeiro, Brazil. *Dermatol*. August 2011; 86 (4): 689-93.
- [14] Gupta M, Sharma NL, Kanga AK, Mahajan VK, Tegta GR. Onychomycosis: Clinico-mycologic study of 130 patients from Himachal Pradesh, India. *Indian J Dermatol Venereol Leprol*. 2007;73:389-92.
- [15] Kaur R, Kashyap B, Bhalla P. A five-year survey of onychomycosis in New Delhi, India: Epidemiological and laboratory aspects. *Indian J Dermatol*. 2007;52:39-42.
- [16] Geramishoar M, Zomorodian K, Emami M, Tarazoei B, Saadat F. Study and Identification of the Etiological Agents of Onychomycosis in Tehran, Capital of Iran. *Iranian J. Publ. Health*. 2002;31:100-04.
- [17] Zaini F, Mahmoudi M, Mehbod ASA, Kordbacheh P, Safara M. Fungal Nail Infections in Tehran, Iran. *Iranian J. Publ. Health*. 2009;38:46-53.
- [18] Bramono K, Budimulja U. Epidemiology of Onychomycosis in Indonesia. *Jpn. J. Med. Mycol*. 2005;46(3):171-76.
- [19] Brillhante RSN, Cordeiro RA, Medrano DJA, Rocha MFG, Monteiro AJ, Cavalcante CSP et al. Onychomycosis in Ceará (Northeast Brazil): epidemiological and laboratory aspects. *Mem. Inst. Oswaldo Cruz*. [serial on the Internet]. 2005 Apr [cited 2012 Nov 29]; 100(2): 131-35.

### AUTHOR(S):

1. Dr. Prakash Gelotar
2. Dr. Swati Vachhani
3. Dr. Bhargav Patel
4. Dr. Naresh Makwana

### PARTICULARS OF CONTRIBUTORS:

1. Assistant Professor, Department of Microbiology,
2. Resident, Department of Microbiology,
3. Resident, Department of Microbiology
4. Associate Professor, Department of Community Medicine, Shri M. P. Shah Medical College Jamnagar, Gujarat, India.

### NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Prakash Gelotar,  
Assistant Professor, Department of Microbiology,  
Shri M. P. Shah Medical College,  
Jamnagar, Gujarat, India.  
Phone: 09825193498  
E-mail: drprakash\_md@yahoo.co.in

### FINANCIAL OR OTHER COMPETING INTERESTS:

None.

Date of Submission: **Nov 02, 2012**  
Date of Peer Review: **Nov 26, 2012**  
Date of Acceptance: **Dec 12, 2012**  
Date of Online Ahead of Print: **Dec 24, 2012**  
Date of Publishing: **Feb 01, 2013**