

## A Clinico-mycological Study of Onychomycosis with Dermatophytoma

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### = Abstract =

**Background:** Although there have been many studies about onychomycosis, the study about onychomycosis with dermatophytoma has not been reported yet in Korea.

**Objective:** The purpose of this study was to investigate the clinical characteristics and treatment strategies of the onychomycosis with dermatophytoma compare with the other onychomycosis.

**Methods:** In the 5-year period 2007-2011, we reviewed forty five patients with toenail onychomycosis with dermatophytoma, proven by direct potassium hydroxide examination. The etiological agents were identified by cultures on Sabouraud's dextrose agar with and without cycloheximide. To confirm dermatophytoma, we performed histopathologic evaluation of the nail plate by nail clipping.

**Results:** Toenail onychomycosis with dermatophytoma were 2.9% of all onychomycosis. Among the age groups, the incidence rate was highest in the sixties (24.4%). The ratio of male to female patients was 1:1.1. The frequency of associated disease was highest in diabetes mellitus (17.7%). The right great toenail was most common affected nails. Distal and lateral subungual onychomycosis (88.9%) was the most common clinical type. The round lesion was most common clinical features of affected area (66.7%), followed by linear lesion (33.3%). *Trichophyton rubrum* was most common etiological agent (57.8%). The partial removal of the toenail combined with oral and topical antifungal agent was most common in treatment of onychomycosis with dermatophytoma.

**Conclusion:** Because of the increase in onychomycosis with dermatophytoma, and its relative resistance to the conventional treatment of onychomycosis, we suggest the need of a careful mycological examination to diagnose the dermatophytoma in patients with onychomycosis, and we also propose more aggressive treatment strategy is required to treat dermatophytoma.

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**Key Words:** Dermatophytoma, Onychomycosis

### INTRODUCTION

Onychomycosis denotes any infection of nail

due to dermatophytes, nondermatophytic molds, or yeasts. Dermatophytes are by far the most common causal organisms, and toenails are commonly affected. The increasing prevalence of this disease

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**Fig. 1.** Whitish round patch with subungual hyperkeratosis on the right great toenail.



**Fig. 2.** Yellowish linear streak on the right great toenail.

may be secondary to tight shoes, increasing numbers of immunosuppressed individuals, and increased use of communal locker rooms<sup>1</sup>.

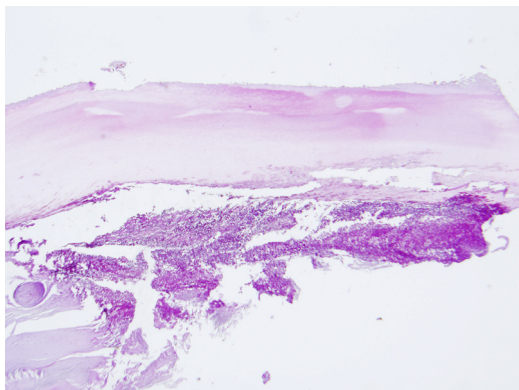
Dermatophytoma was firstly described in 1998 by Roberts and Evans<sup>2</sup> as an uncommon clinical manifestation of onychomycosis caused by dermatophytes. Clinically, the dermatophytoma is presented with a linear or round mass of yellowish or white color. Histology of this mass shows densely packed clump of dermatophyte hyphae which is under the nail plate or on the nail bed. It is analogous in some ways to an aspergilloma which occurs in the lung, and consists of densely packed and abnormal fungal elements, so that dermatophytoma in the nail is likely to have the same treatment implications as an aspergilloma<sup>2</sup>. It is probable that antifungal drug penetration into such lesions does not achieve adequate concentrations<sup>2-9</sup>. There has been only one case report about the treatment of dermatophytoma in Korean dermatologic literatures<sup>10</sup>. The purpose of this study

was to investigate clinical features and isolated pathogens of dermatophytoma during the last 5 years.

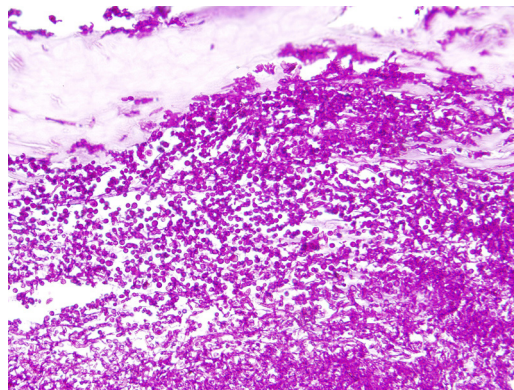
## MATERIALS AND METHODS

### 1. Study subjects

The 1,545 patients were diagnosed with onychomycosis by 20% KOH test at the department of dermatology, Dongguk university Gyeongju hospital in the 5-year period 2007-2011. Of these patients, this study included 45 patients with dermatophytoma according to the diagnosis criteria of dermatophytoma<sup>2,4</sup>, which showed clinically linear or round mass of yellowish or white color, and histologically densely packed clump of dermatophyte hyphae under the nail plate or on the nail bed. The clinical features and histological findings of all the patient with dermatophytoma was coincided with the diagnostic criteria (Fig. 1-4).



**Fig. 3.** Densely packed clump of thick walled hyphae on the underside of toenail plate (PAS stain,  $\times 100$ ).



**Fig. 4.** High magnification view of toenail plate (PAS stain,  $\times 400$ ).

## 2. Methods

### 1) Clinical features

The medical records of the 45 patients were retrospectively analyzed in terms of clinical features, concurrent disease and treatment strategies. According to the classification of Baran et al.<sup>11</sup>, we classified onychomycosis into 5 clinical types, distal and lateral subungual onychomycosis (DLSO), superficial white onychomycosis (SWO), proximal subungual onychomycosis (PSO), endonyx onychomycosis (EO) and total dystrophic onychomycosis (TDO).

### 2) Potassium hydroxide test, fungal culture and identification of causative pathogens

After the nail was sterilized with 75% alcohol, we obtained the sample by scraping the hyperkeratotic nail bed with disposable scalpel. Nail samples were microscopically studied after clearing for 5 minutes in 20% potassium hydroxide (KOH). For cultures, each specimen was inoculated on Sabouraud's dextrose agar (SDA) with and without 0.5 mg/ml cyclohexamide and incubated at room temperature for 2~4 weeks. Causative pathogens were identified based on gross and microscopic findings of colonies. The pathogen of onychomycosis was defined, according to a modification

of the English criteria<sup>12</sup>, when 15% KOH test was positive, 3  $\geq$  identical colonies were found in fungus cultures, and the identical fungi were identified in repeated fungus cultures.

### 3) Histopathological examination

To confirm dermatophytoma, we performed histopathologic evaluation of suspected linear or round area of the nail plate by partial excision using carbon dioxide laser followed by nail avulsion. The collected nail specimens were fixed and kept in 10% formalin solution<sup>13,14</sup>. To make the nail specimen soften, the fixed nails were soaked in 20% potassium hydroxide for 30 minutes to one hour. Then the specimen were embedded in paraffin and stained by Periodic acid schiff (PAS). Each nail specimen measured 3-5mm, and sliced them into 2~5 pieces each, and then examined by light microscope, which showed densely packed fungal hyphae (Fig. 3, 4).

## RESULTS

### 1. Yearly variations in incidence

The total number of patients with onychomycosis was 1,545. Of these patients, 45 showed dermatophytoma, accounting for 2.9% of all onychomycosis cases. The incidence when the patients

**Table 1.** Age and sex distribution in patients with dermatophytoma

Age group (year)	Male (%)	Female (%)	Total (%)
0~9	-	-	-
10~19	-	-	-
20~29	1 (4.5)	-	1 (2.2)
30~39	1 (4.5)	6 (26.2)	7 (15.6)
40~49	4 (18.2)	4 (17.4)	8 (17.7)
50~59	3 (13.7)	4 (17.4)	7 (15.6)
60~69	8 (36.4)	3 (13.0)	11 (24.4)
70~79	4 (18.2)	3 (13.0)	7 (15.6)
80~89	1 (4.5)	3 (13.0)	4 (8.9)
Total	22 (48.9)	23 (51.1)	45 (100.0)

was diagnosed as dermatophytoma was highest in 2011 (n = 15, 33.3%), and lowest in 2007, 2009 (n = 6, 13.3%). There was an increase in the incidence every year.

**2. Monthly and seasonal variations in incidence**

In terms of monthly variations in incidence, 7 patients developed dermatophytoma in July, 6 patients in February, 5 patients in June and December, 4 patients in October, 3 patients each in January, August, September and November, and 2 patients each in March, April and May. 15 patients developed dermatophytoma during the summer (June through August), 14 patients during the winter (December through February), 10 patients during the fall (September through November), and 6 patients during the spring (March through May).

**3. Age and sex**

Dermatophytoma occurred most commonly among sixties (n = 11, 24.4%), followed by those among forties (n = 8, 17.7%) and those among

**Table 2.** Duration of the dermatophytoma

Duration (year)	Number of patients (%)
<1	5 (11.1)
1~4	14 (31.1)
5~9	12 (26.7)
10~19	9 (20.0)
≤20	5 (11.1)
Total (%)	45 (100.0)

thirties, fifties, seventies (n = 7, 15.6%). Overall, dermatophytoma occurred frequently in patients between their 30s and 70s. There was no patient under age 18 (Table 1). The male patients to female patients ratio was 1:1.1 (22 male and 23 female).

**4. Duration of the onychomycosis with dermatophytoma**

In relation to duration of the onychomycosis with dermatophytoma, it most commonly persisted for 1 to 4 years in 14 patients (31.3%). In 12 patients (26.7%), it persisted 5 to 9 years, and in 9 patients (20.0%), it persisted 10 to 19 years. In the each 5 patients (11.1%), it persisted for less than 5 years or over 20 years (Table 2).

**5. Associated disease**

Concurrent diseases occurred in 18 (40.0%) out of 45 patients with dermatophytoma. Diabetes mellitus comprised the highest proportion (17.7%) with 8 cases. In addition, hypertension (5 cases; 11.1%), malignant neoplasm (2 cases; 4.4%), cerebral hematoma (1 case; 2.2%), cerebral infarction (1 case; 2.2%), hyperthyroidism (1 case; 2.2%), liver cirrhosis (1 case; 2.2%), pulmonary tuberculosis (1 case; 2.2%) were also accompanied (Table 3).

**6. Sites of nail involvement**

Of the 45 patients with dermatophytoma, most

patients showed involvement of only first toenail (n = 41; 91.2%). In 1 (2.2%) patient showed involvement of multiple toenails including the first toenail. 3 patients (6.6%) showed involvement of multiple toenails excluding the first toenail. Also, 27 patients (60.0%) showed involvement of right side of toenails alone, 15 patients (33.3%) showed involvement of left side of toenails alone, 3 patients (6.7%) showed involvement of both side of toenails (Table 4).

### 7. Clinical type

As for the clinical type of dermatophytoma, DLSO was most common (n = 40, 88.9%), followed by TDO (n = 5, 11.1%). There was no SWO, PSO and endonyx type (Table 5).

**Table 3.** Associated diseases in patients with dermatophytoma

Associated diseases	Number of patients (%) n = 45
Diabetes mellitus	6 (13.3)
Diabetes mellitus + Hypertension	2 (4.4)
Hypertension	3 (6.7)
Malignancy (cervix, breast)	2 (4.4)
Cerebral hematoma	1 (2.2)
Cerebral infarction	1 (2.2)
Hyperthyroidism	1 (2.2)
Liver cirrhosis	1 (2.2)
Pulmonary tuberculosis	1 (2.2)
Total	18 (40.0)

**Table 4.** Sites of toenail involvement in patients with dermatophytoma

Only right first nail (%)	First nail		Other than first nail		
	Only left first nail (%)	Both right & left nail (%)	Left first & third nail (%)	Right second nail (%)	Left third nail (%)
25 (55.6)	13 (28.9)	3 (6.7)	1 (2.2)	2 (4.4)	1 (2.2)

### 8. Clinical presentations of lesion

Of the onychomycosis patients with dermatophytoma, round lesion was most common (n = 30, 66.7%), followed by linear lesion (n = 15, 33.3%). Of the 30 round lesions, 28 cases showed yellowish color and 2 cases showed white color. Likewise, of the 15 linear lesion, 12 cases showed yellowish color, and 3 cases showed white color. Overallly 40 (88.9%) cases showed yellowish color, 5 (11.1%) cases showed white color (Table 6). In 40 cases of DLSO, 25 cases showed round lesion and 15 cases showed linear lesion. In 5 cases of TDO, all the 5 cases showed round lesion and there was no linear lesion (Table 7).

### 9. Isolated causative pathogens

The causative pathogens of patients with dermatophytoma were isolated by fungal culture in 26 out of 45 cases, exclusive of 13 (28.9%) cases of contaminants and 6 (13.3%) cases of negative

**Table 5.** Classification of dermatophytoma according to the clinical types

Clinical type	Number of patients (%)
DLSO	40 (88.9)
SWO	0 (0.0)
PSO	0 (0.0)
TDO	5 (11.1)
Total	45 (100.0)

DLSO: distal and lateral subungual onychomycosis, SWO: superficial white onychomycosis, PSO: proximal subungual onychomycosis, TDO: total dystrophic onychomycosis

**Table 6.** Clinical features of affected area in dermatophytoma

Clinical features	Number of patients (%)
Round lesion	30 (66.7)
Yellow color	28
White color	2
Linear lesion	15 (33.3)
Yellow color	12
White color	3
Total	45 (100.0)

cultures. In result, the positive culture rate was 57.8%. Only *Trichophyton(T.) rubrum* was isolated in all 26 cases (Table 8).

**10. Treatment regimens**

Out of the 45 patients with dermatophytoma, 32 patients (71.1%) were partially removed their toenails by using a carbon dioxide laser, followed by nail clipping surgery. These patients were also treated by the oral administration of itraconazole or terbinafine and the application of antifungal nail lacquer. 7 patients were only treated by oral antifungal agents with antifungal nail lacquer because their systemic conditions were not suitable for surgery. And the rest of 6 patients (13.3%), who had hepato-renal dysfunctions, or simply refused surgery or oral antifungal agents, were treated with topical antifungal nail lacquer only. Among the 32 patients who underwent surgical clipping of dermatophytoma, 15 patients was followed up for 1 year, and there was no recurrence during the follow-up period. Unfortunately, the treatment outcome of the rest of 17 patients were not followed up, so we cannot conclude the efficacy of nail clipping surgery.

**Table 7.** Classification of dermatophytoma according to the clinical types and features

Clinical type	Number of patients (%)
DLSO	40 (88.9)
Round lesion	25
Linear lesion	15
TDO	5 (11.1)
Round lesion	5
Linear lesion	0
Total	45 (100.0)

DLSO: distal and lateral subungual onychomycosis, TDO: total dystrophic onychomycosis

**Table 8.** Fungal strains isolated in patients with dermatophytoma

Species	Number of strains (%)
<i>Trichophyton rubrum</i>	26 (57.8)
Contaminants	13 (28.9)
No growth	6 (13.3)
Total	45 (100.0)

**DISCUSSION**

Medically confirmed onychomycosis should be treated. This recommendation is based on several disease-specific considerations: cosmetic and functional disability, lack of spontaneous remission, impairment of health and well-being in elderly patients, and the need to reduce contamination in communal bathing places<sup>9</sup>. Onychomycosis with dermatophytoma is recalcitrant to treatment because the penetration of antifungal medication into such lesions does not achieve adequate concentrations<sup>2-9</sup>.

In this study, onychomycosis with dermatophytoma accounted for 2.9% of all onychomycosis, which is higher than 0.9% of Martinez-Herrera et al<sup>5</sup>. There was an increase in the incidence every

year. However, this study was only confined to our hospital, and the number of patients included in this study is not meaningfully high, this result has some limitation. The monthly and seasonal incidence was highest in summer which is consistent with other reports<sup>9,15-17</sup> but not consistent with Hwang et al.<sup>18</sup> that the incidence of onychomycosis was highest in winter. It might be because the chance of exposure of nails to other person is much higher in summer, and most patient with onychomycosis pay more attention to their personal hygiene care than other seasons. Onychomycosis with dermatophytoma showed the highest incidence in the sixties (24.4%) as in the report of Hwang et al.<sup>18</sup> on onychomycosis in adult (30.7%). And patients aged between 30 and 70 were most common as the study of Martinez-Herrera et al.<sup>5</sup> that patients aged between 23 and 73 were most common. The male to female ratio was 1:1.1. In this study, onychomycosis with dermatophytoma most commonly persisted 1 to 4 years (31.1%) similarly to the study of Hwang et al.<sup>18</sup> (45.1%) but it persisted longer than the study of Martinez-Herrera et al.<sup>5</sup> that 6 months were most common.

Concurrent diseases were found in 40.0% of patients. Diabetes mellitus was the most common concurrent disease (17.7%), followed by hypertension (11.1%). Likewise the study of Hwang et al.<sup>18</sup>, diabetes mellitus and hypertension were common. It has been demonstrated that systemic diseases, such as diabetes mellitus, frequently caused onychomycosis<sup>19,20</sup>. Diabetes mellitus frequently associated with dermatophytoma in this study as well, thus diabetes mellitus also seems to be related with dermatophytoma.

There were a few studies have determined the prevalence of onychomycosis in diabetic subjects. But the distinct pathogenesis of this susceptibility is not well understood. Increased incidence of onychomycosis in diabetes subjects might be

because most of the patients with diabetes mellitus has impaired peripheral circulation, which result in more susceptible to onychomycosis and dermatophytoma as well.

According to the other studies<sup>2,15,18,21</sup>, toenail onychomycosis occurred 80.0~93.8% of all onychomycosis cases. In this study, all patients with dermatophytoma showed the involvement of toenail alone, and involvement of only first toenail comprised the highest proportion (91.2%). There are slight differences with other reports<sup>15,18,21</sup> that onychomycosis commonly occurred multiple nails including first toenail. There was no fingernail dermatophytoma neither in our study nor in other reports<sup>2,5</sup>. Because the growth rate of fingernail is more faster than toenail, the incidence of dermatophytoma in fingernail is relatively much lower than in toenail.

In our study, DLSO was found in 88.9% of patients, which was consistent with the reported results<sup>15,18,21</sup>. TDO was 11.1% in our study and Martinez-Herrera et al.<sup>5</sup> reported that TDO comprised 42.9% of onychomycosis with dermatophytoma. These proportion of TDO subtype is higher than 3.4~8.8% in other reports of onychomycosis with or without dermatophytoma<sup>18,21</sup>. It is suggested that dermatophytoma commonly occur in patients with TDO type of onychomycosis. Clinically, dermatophytoma has been described as a linear or round lesion of affected toenail<sup>2,4</sup>. Martinez-Herrera et al.<sup>5</sup> reported that all dermatophytoma showed linear lesion. However, the round lesion comprised 66.7% and the linear lesion were 33.3% in this study. It seems that more case reports are necessary to clarify the incidence of each clinical feature of dermatophytoma. It is reported that the affected lesion of dermatophytoma shows yellowish or white color<sup>4,5</sup>. In this study, 88.9% of cases showed yellowish color and 11.1% of cases showed white color which is consistent with Martinez-Herrera et al.<sup>5</sup>

(yellowish color; 57.1%, white color; 42.9%). However Roberts and Evans<sup>2</sup> who firstly described dermatophytoma reported only white color of cases.

In this study, similar to the report of Martinez-Herrera et al.<sup>5</sup>, the causative pathogen of all patients with dermatophytoma was *T. rubrum*, and other dermatophytes including *T. mentagrophytes*, *Microsporum gypseum* were not isolated.

Because penetration of antifungal drug into dermatophytoma lesions does not achieve adequate concentration, so that surgical or chemical removal of the diseased nail is required<sup>2-9</sup>. Lecha et al.<sup>8</sup> reported that the partial removal of the nail can be most effective option in patients with dermatophytoma. In this study, the patients who is suitable for surgery, was treated by partial removal of the affected nail in combination with oral and topical antifungal treatment. Alternatively, Martinez-Herrera et al.<sup>5</sup> treated the patients with dermatophytoma by chemical avulsion with 40% urea and 1% bifonazole.

In this study, a number of patients with dermatophytoma were found by clinical examinations and isolation of causative pathogen. The results of this study suggest that dermatologist should be concerned about dermatophytoma when diagnose as onychomycosis, and make more effort to improve treatment outcome.

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