

## A Clinical and Mycological Study of Onychomycosis in the Elderly Over 10 Years (2001-2010)

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### = Abstract =

**Background:** As the life expectancy has risen globally because of the advance of medicine, onychomycosis in the elderly has been increasing with higher concerns over nails. Onychomycosis has been studied quite extensively, however, few reports on onychomycosis in a geriatric Korean population have been available.

**Objective:** The purpose of this study was to investigate the clinical features of onychomycosis in the elderly compared with other age groups and to identify the etiological agents during 10-year period.

**Methods:** A total of 629 patients over 65 years of age had been diagnosed with onychomycosis during a 10-year period (2001-2010). The etiological agents were identified by cultures on Sabouraud's dextrose agar with and without cycloheximide. Nondermatophytic molds and yeasts were considered as pathogens, if the identical fungal elements were observed at the initial direct microscopy and repeatedly in specimen-yielding cultures at a follow-up visit.

**Results:** The 629 elderly patients represented 22.1% of all onychomycosis patients. Toenails were involved in 567 (90.1%) patients; fingernails in 39 (6.2%); both toenails and fingernails in 23 (3.7%). The ratio of male to female was 1.01:1. Associated systemic diseases were found in 327 (52.0%) cases. Distal and lateral subungual onychomycosis (80.2%) was the most common clinical type of onychomycosis, followed by TDO (10.7%), SWO (6.2%) and PSO (2.9%). TDO was increasing significantly in the elderly. Organisms causing onychomycosis were dermatophytes (76.5%), yeasts (14.3%) and nondermatophytic molds (9.2%). The most common cause of onychomycosis in the elderly was *Trichophyton rubrum*. Nondermatophytic molds were more frequently responsible for onychomycosis in the elderly.

**Conclusion:** Onychomycosis has been increased in the elderly and there are many differences from other age groups in aspects of clinical features, associated diseases and etiologic agents. Therefore, we suggest the need of a careful mycological examination in the elderly patients with onychomycosis.

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## INTRODUCTION

Onychomycosis denotes nail infection from dermatophytes, nondermatophytic molds, or yeasts while tinea unguis refers specifically to the infection of the nail plate by dermatophytes. Nail infections have been prevailing lately due to not only the increased exposure to various fungi after the use of ill-fitting shoes and public lockers in sport facilities, but the increase of immuno-suppressed individuals. Onychomycosis is the most common nail disease, accounting for approximately 50 percent of all onychopathies<sup>1</sup>. As the life expectancy has risen globally because of the advance of medicine, onychomycosis in the elderly has been increasing with higher concerns over nails<sup>2-14</sup>. Studies on onychomycosis have been reported several times in Korea<sup>15-25</sup>, however, the elderly cases have not received considerable attention<sup>26,27</sup>. Therefore, this study was designed to investigate clinical features and etiological agents of onychomycosis in the elderly during a 10-year period.

## MATERIALS AND METHODS

### 1. Study subjects

A retrospective review of onychomycosis cases at the Department of Dermatology, Dongguk University Gyeongju Hospital in the 10-year period of January 2001 to December 2010 screened out the elderly patients over 65 years of age. Among the 629 elderly patients who revealed the clinical signs typical for onychomycosis and diagnosed by 15% potassium hydroxide (KOH) test and fungal cultures, 23 patients suffered simultaneous infection in both fingernails and toenails, comprising a total of 652 cases: 590 cases of toenail onychomycosis; 62 cases of fingernail onychomycosis.

## 2. Methods

### 1) Clinical features

The medical records of the 629 elderly patients with onychomycosis were reviewed to investigate the yearly/monthly/seasonal incidence, age, gender, duration of disease, concurrent disease, sites of nail involvement, clinical types, and treatment strategies. According to the classification by Baran et al.<sup>28</sup>, all cases were classified into five 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) Fungal test, fungal culture and identification of causative pathogens

Nail specimens were obtained from the nail lesions after disinfection by 75% alcohol, treated with 15% KOH, and then examined for fungal elements. For fungal cultures, each specimen was inoculated on three separate locations of a Sabouraud's dextrose agar slant (with and without 0.5 mg/ml cycloheximide) and incubated at room temperature for 2 to 4 weeks. The causative agents were identified based on the gross and microscopic presence of fungal colonies, while yeasts were identified by germ tube test and API 20C kit (Bio-Merieux, Marcy l'Etoile, France). Using modified English criteria<sup>29</sup>, dermatophytes were considered as pathogens when cultured, but onychomycosis due to nondermatophytic molds or yeasts was defined if the 15% KOH test was positive, 2~3 identical colonies were found in fungal cultures, and the same fungus was identified in repeated cultures.

## RESULT

### 1. Yearly incidence

During a 10-year period (January 2001 to

December 2010), there were 629 (22.1%) elderly patients among a total of 2,840 onychomycosis patients. The yearly incidence was the highest in 2008 (n=85, 13.5%) and the lowest in 2002 (n=43, 6.8%). The incidence rate showed the increasing tendency (Fig. 1).

## 2. Monthly and seasonal incidence

In terms of the monthly incidence, the initial

hospital visits were made by 79 elderly patients in August; 73 in July; 54 in June and September each; 53 in April and May each; 50 in March; 47 in October; 45 in February; 43 in January; 41 in December; 37 in November. Therefore, 206 (32.8%) elderly patients visited in summer (June to August); 156 (24.8%) in spring (March through May); 138 (21.9%) in autumn (September through November); 129 (20.5%) in winter (December through Feb-

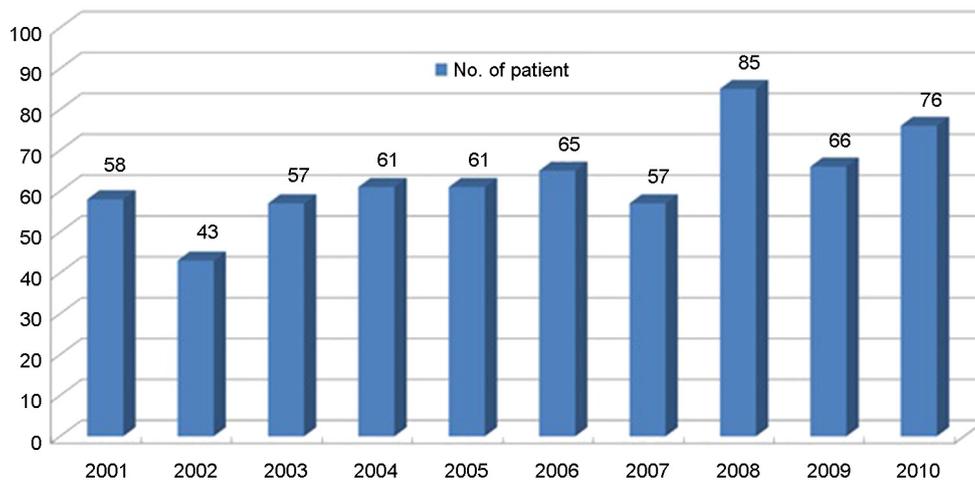


Fig. 1. Annual incidence of the elderly patients with onychomycosis.

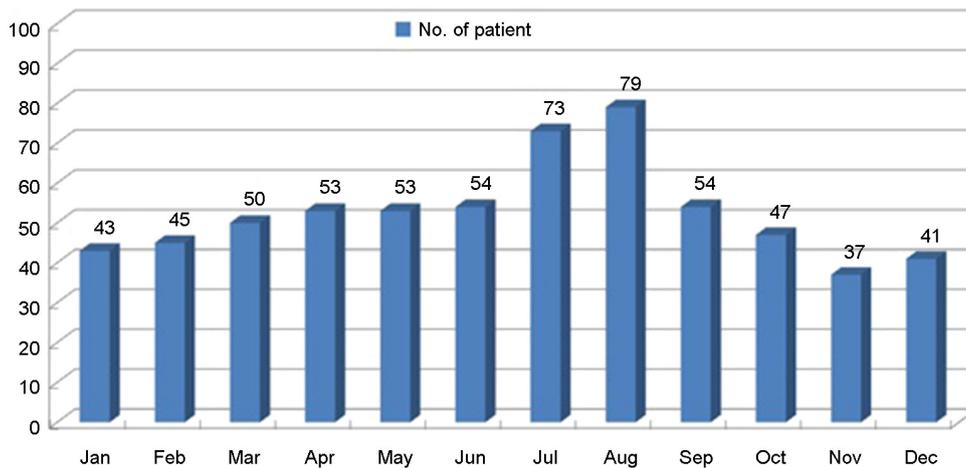


Fig. 2. Monthly distribution of the elderly patients with onychomycosis.

**Table 1.** Age and sex distribution in the elderly patients with onychomycosis

Age (year)/ Sex	Male (%)	Female (%)	Total (%)
65~69	130 (41.1)	116 (37.1)	246 (39.1)
70~74	92 (29.1)	105 (33.5)	197 (31.3)
75~79	64 (20.3)	56 (17.9)	120 (20.0)
80~84	19 (6.0)	29 (9.3)	48 (7.7)
85~89	7 (2.2)	7 (2.2)	14 (2.2)
90~	4 (1.3)	0 (0.0)	4 (0.7)
Total	316 (56.2)	313 (49.8)	629 (100.0)

ruary) (Fig. 2).

### 3. Age and sex

The prevalence of onychomycosis was determined in the age groups: 65~69 years (n=246, 39.1%); 70~74 years (n=197, 31.3%); 75~79 years (n=120, 20.0%); 80~84 years (n=48, 7.7%); 85~89 years (n=14, 2.2%); over 90 years (n=4, 0.7%). The male-to-female ratio was 1.01:1 with 316 (50.2%) males and 313 (49.8%) females (Table 1).

### 4. Duration of onychomycosis

Duration of onychomycosis in the elderly was also checked: 198 (31.5%) patients suffered for longer than 10 years; 192 (30.5%) for 1~4 years; 150 (23.9%) for 5~9 years; 63 (10.0%) for less than a year (Table 2).

### 5. Associated disease with onychomycosis

Among 629 elderly patients with onychomycosis, 327 (52.0%) had associated diseases. Hypertension was found in 99 (15.7%) patients, diabetes mellitus in 77 (12.2%), hypertension plus diabetes mellitus in 41 (6.5%), lung disease in 21 (3.3%), heart disease in 17 (2.7%), kidney disease in 13 (2.1%), liver disease in 11 (1.8%), malignancy in 10

**Table 2.** Duration of the onychomycosis in the elderly

Duration (year)	Number of patients (%)
<1	63 (10.0)
1~4	192 (30.5)
5~9	150 (23.9)
≥10	198 (31.5)
Unknown	26 (4.1)
Total	629 (100.0)

**Table 3.** Associated diseases in the elderly with onychomycosis (n=629)

Associated diseases	Number of patients (%)
Hypertension	99 (15.7)
Diabetes mellitus	77 (12.2)
Diabetes mellitus + Hypertension	41 (6.5)
Pulmonary diseases	21 (3.3)
Heart diseases	17 (2.7)
Kidney diseases	13 (2.1)
Liver diseases	11 (1.8)
Malignancy	10 (1.6)
Arthritis	6 (1.0)
Other diseases	32 (5.1)
Total	327 (52.0)

(1.6%), arthritis in 6 (1.0%), and other diseases in 32 (5.1%) (Table 3).

### 6. Sites of nail involvement

Toenail onychomycosis, fingernail onychomycosis, and toenail and fingernail onychomycosis were present in 567 (90.1%) patients, 39 (6.2%), and 23 (3.7%), respectively.

Among the toenail involvement of 590 cases, 524 (88.8%) cases were multiple toenail involvement including a big toenail, 50 (8.5%) cases involved only big toenail, while 16 (2.7%) cases

**Table 4.** Sites of nail involvement in the elderly with onychomycosis (n=652\*)

	First nail		Others than first nail (%)	Total	Number of nails involved		
	Only first nail (%)	First and other nails (%)			1~2 (%)	3~4 (%)	≥5 (%)
Toenail	50 (8.5)	524 (88.8)	16 (2.7)	590	71 (12.0)	96 (16.3)	423 (71.7)
Fingernail	35 (56.5)	17 (27.4)	10 (16.1)	62	43 (69.3)	13 (21.0)	6 (9.7)

\*Twenty-three patients had simultaneous infection of toenails and fingernails, resulting in a total of 652 cases.

**Table 5.** Clinical types of onychomycosis in the elderly

Clinical type	Toenail onychomycosis (%)	Fingernail onychomycosis (%)	Total (%)
DLSO	497 (82.5)	36 (58.1)	523 (80.2)
SWO	31 (5.3)	9 (14.5)	40 (6.2)
PSO	9 (1.5)	10 (16.1)	19 (2.9)
TDO	63 (10.7)	7 (11.3)	70 (10.7)
Total	590 (90.5)	62 (9.5)	652 (100.0)

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

involved multiple toenails excluding a big toenail.

Among the fingernail involvement of 62 cases, thumbnail involvement was most common in 35 (56.5%) cases in difference from the toenail involvement, multiple involvement of fingernails including a thumbnail was found in 17 (27.4%) cases, while multiple involvement excluding a thumbnail was in 10 (16.1%) cases.

In terms of the numbers of nail involvement, more than 5 toenails were involved in 423 (71.7%) cases; 3~4 toenails in 96 (16.3%) cases; 1~2 toenails in 71 (12.0%) cases. In contrast, 1~2 fingernails were involved in 43 (69.3%) cases; 3~4 fingernails in 13 (21.0%) cases; more than 5 finger nails in 6 (9.7%) cases (Table 4).

### 7. Clinical type

DLSO (n=497, 82.5%) was the most common type of toenail onychomycosis in the elderly, followed by TDO (n=63, 10.7%), SWO (n=31,

5.3%), and PSO (n=9, 1.5%). As seen in the toenail cases, DLSO (n=36, 58.1%) was the most common type of fingernail onychomycosis in the elderly, followed by PSO (n=10, 16.1%), SWO (n=9, 14.5%), and TDO (n=7, 11.3%). Collectively, DLSO was the most common type of onychomycosis in the elderly with 523 (80.2%) cases. TDO was the secondly common type with 70 (10.7%) cases, while SWO was found in 40 (6.2%) cases, and PSO was in 19 (2.9%) cases (Table 5). In addition, there were 98 (15.0%) cases of onycholysis, 54 (8.3%) cases of yellow spike, and 32 (4.9%) cases of dermatophytoma.

## 8. Isolated causative pathogens

### 1) Toenail onychomycosis

Among 590 cases of toenail onychomycosis, 338 (57.3%) cases were culture-positive excluding 150 (25.4%) cases with contaminated culture results and 102 (17.3%) culture-negative cases.

**Table 6.** Fungi isolated from the elderly with onychomycosis (n=379)

Fungi	Toenail onychomycosis (%)	Fingernail onychomycosis (%)	Total (%)
Dermatophytes	272 (80.5)	18 (43.9)	290 (76.9)
Yeasts	36 (10.6)	18 (43.9)	54 (14.3)
Molds	30 (8.9)	5 (12.2)	35 (9.2)
Total	338 (89.2)	41 (10.8)	379 (100.0)

Dermatophytes were the most commonly isolated fungi from 272 (80.5%) cases, followed by yeasts from 36 (10.6%) cases, and non-dermatophytes from 30 (8.9%) cases (Table 6). *Trichophyton (T.) rubrum* was the most commonly isolated dermatophyte with 257 isolates, followed by *T. mentagrophytes* with 15 isolates. *Candida (C.) albicans* was the most common yeast with 14 isolates, *C. parapsilosis* 13 isolates, each of *C. tropicalis*, *C. guilliermondii* and unidentified yeasts 3 isolates. Among non-dermatophytes, *Aspergillus* were 26 isolates (*A. niger* 10 isolates; *A. fumigatus* 7 isolates; *A. flavus* 6 isolates; *A. terreus* 2 isolates; *A. sydowii* 1 isolate), *Scopulariopsis (S.) brevicaulis* 3 isolates, *Fusarium (F.) solani* 1 isolate (Table 7).

## 2) Fingernail onychomycosis

Among 62 cases of fingernail onychomycosis, 41 (66.1%) isolates were identified from fungal cultures, while 11 cases were turned out as contaminants, and 10 cases as culture-negative. Dermatophytes and yeasts were most commonly detected from 18 (43.9%) cases each, whereas non-dermatophytes were from 5 (12.2%) cases (Table 6). *T. rubrum* was the most common dermatophyte with 17 isolates, and *T. mentagrophytes* 1 isolate. *C. albicans* was the most common yeast with 11 isolates, *C. parapsilosis* 4 isolates, and each of *C. tropicalis*, *C. guilliermondii*, and unidentified yeast 1 isolate. Among nondermatophytic molds, *Aspergillus* spp. was identified with 5 isolates (*A. niger* 3 isolates; *A. fumigatus* 2 isolates) (Table 7).

## 3) Toenail and fingernail onychomycosis

In total, dermatophytes were isolated from 290 (76.5%) cases, yeasts from 54 (14.3%) cases, non-dermatophytic molds from 35 (9.2%) cases (Table 6). *T. rubrum* was the most frequently detected dermatophytes with 274 isolates, followed by *T. mentagrophytes* with 16 isolates. Among yeasts, *C. albicans* were most frequently identified with 25 isolates, followed by *C. parapsilosis* with 17 isolates and each of *C. tropicalis*, *C. guilliermondii* and unidentified yeasts with 4 isolates. *Aspergillus* spp. were most common with 31 isolates (*A. niger* 13 isolates; *A. fumigatus* 9 isolates; *A. flavus* 6 isolates; *A. terreus* 2 isolates; *A. sydowii* 1 isolate) among nondermatophytic molds, followed by *S. brevicaulis* 3 isolates and *F. solani* 1 isolate (Table 7).

## 9. Treatment regimens

A combination therapy of oral antifungal agents with nail lacquer or cream was used for 3 months: itraconazole for 258 (41.0%) patients and terbinafine for 236 (37.5%), while a monotherapy with antifungal nail lacquer or cream was applied for 112 (17.8%). The patients whose KOH test was positive after 6 months received additional treatment for 1 month. In the cases revealing poor response to therapy as seen in dermatophytoma, 23 (3.7%) elderly patients were treated with carbon dioxide laser for partial removal of nails involved, and received the oral administration of itraconazole or terbinafine combined with antifungal nail lacquer

**Table 7.** Fungal strains isolated from the elderly with onychomycosis

Species	Number of strains		Total
	Toenail onychomycosis	Fingernail onychomycosis	
Dermatophytes	272	18	290
<i>Trichophyton rubrum</i>	257	17	274
<i>Trichophyton mentagrophytes</i>	15	1	16
Yeasts	36	18	54
<i>Candida albicans</i>	14	11	25
<i>Candida parapsilosis</i>	13	4	17
<i>Candida tropicalis</i>	3	1	4
<i>Candida guilliermondii</i>	3	1	4
Unidentified yeasts	3	1	4
Molds	30	5	35
<i>Aspergillus niger</i>	10	3	13
<i>Aspergillus fumigatus</i>	7	2	9
<i>Aspergillus flavus</i>	6		6
<i>Aspergillus terreus</i>	2		2
<i>Aspergillus sydowii</i>	1		1
<i>Scopulariopsis brevicaulis</i>	3		3
<i>Fusarium solani</i>	1		1
Contaminants	150	11	161
No growth	102	10	112
Total	590	62	652

or cream. Antifungal cream was topically used in our hospital until antifungal nail lacquer was introduced in February, 2004. Topical monotherapy was used if the patients refused to take oral medication or had problems in liver or kidney functions.

## DISCUSSION

The elderly subjects with onychomycosis had been the geriatric population 60 years of age and

older<sup>27</sup>, however, 65 years of age has become the standard for the elderly patients as in US and Europe since life expectancy increases<sup>5,12,26</sup>. In this study, onychomycosis in the elderly aged 65 years and over was reviewed.

The prevalence of onychomycosis in the elderly has been increasing in several recent studies<sup>2-14</sup>. The reason for this includes the reduction of T cell function and phagocyte activity, slow growth of nails, delay between the subclinical infection and the development of clinical onychomycosis, and

higher prevalence of tinea pedis<sup>13</sup>. Although the prevalence of onychomycosis in a geriatric population was not determined in this study, the elderly-to-total patients ratio was 22.1% which was comparable to the data of Loo<sup>4</sup> (20%), but higher than that of Sohn and Lee<sup>27</sup> (10.5%) and lower than those of Lim et al.<sup>21</sup> (28.7%) and Hwang et al.<sup>16</sup> (35.6%). As these studies<sup>4,16,21,27</sup> investigated the patients aged 60 years and over, the comparison of our study may not be suitable. In this study, yearly incidence tends to increase slightly toward the latter end of the 10-year period. During hot and humid summer months (August the highest, followed by July and June) hospital visits by the elderly onychomycosis patients were frequently made (32.8%) as previously reported on the onychomycosis study by Lim et al.<sup>21</sup> for whole age groups (36.1%), but somewhat differently from the winter prevalence of onychomycosis study of an adult group by Hwang et al.<sup>16</sup>

As reported by Sohn and Lee<sup>27</sup>, 65 to 69 year-old group showed the highest prevalence of onychomycosis and the older groups did the lower rates. Although it has been known that onychomycosis is observed more frequently in male<sup>13</sup>, the male-to-female ratio in our study was 1.01:1 which was similar to the reports by Lim et al.<sup>21</sup> (1:1.1) and Hwang et al.<sup>16</sup> (1.3:1), but different from the female dominant observation by Sohn and Lee<sup>27</sup> (1:3). Duration of onychomycosis was longer than 10 years in 31.5% of the elderly as observed by Sohn and Lee<sup>27</sup>, suggesting that educating the elderly patients for the early treatment and improved hygiene is very important because the elderly without proper care may transmit the infection to family members<sup>27</sup>.

Associated diseases were observed in 52.0% of the elderly patients, which was higher than 38.2% and 40.4% of the onychomycosis studies by Sohn and Lee<sup>27</sup> and Hwang et al.<sup>16</sup>, respectively. Therefore, the underlying diseases need to be checked

for the elderly onychomycosis patients. Hypertension was the most frequently associating disease, followed by diabetes mellitus as described by others<sup>16,26,27</sup>. Diabetes mellitus is a well known predisposing factor for onychomycosis<sup>30</sup>, while hypertension has not been regarded as a risk factor. Since the diagnostic guideline for hypertension has been inclusively changed, hypertension prevalence has been elevated, resulting in the increase in hypertensive onychomycosis cases.

Toenails were the most affected sites in 567 (90.1%) of the elderly, as described by Sohn and Lee<sup>27</sup> (92.6%), Lim et al.<sup>21</sup> (92.5%), and Hwang et al.<sup>16</sup> (93.8%). Fingernail involvement was seen in 39 (6.2%), which was higher than the data of Lim et al.<sup>21</sup> (5.5%), Hwang et al.<sup>16</sup> (2.2%) and Sohn and Lee<sup>27</sup> (0%). Both toenail and fingernail involvement was observed in 23 (3.7%) which was higher than 2.0% of Lim et al.<sup>21</sup>, but lower than 4.0% of Hwang et al.<sup>16</sup> and 7.4% of Sohn and Lee<sup>27</sup>. Among 590 cases of toenail onychomycosis, the involvement of a big toenail alone and with other toenails was found in 8.5% and 88.8%, respectively. Comparable data were obtained by Lim et al.<sup>21</sup> (17.5% and 75.8%) and Sohn and Lee<sup>27</sup> (19.1% and 79.4%), indicating that infection of a big toenail with other toenails is most common in the elderly onychomycosis. However, Hwang et al.<sup>16</sup> reported that a big toenail alone was found in 32.9% of the adult onychomycosis versus 46.2% with other toenails. In addition, 71.7% cases involved more than 5 toenails, slightly different from 1~2 toenails involvement reported by Lim et al.<sup>21</sup> and Hwang et al.<sup>16</sup> One of the reasons for this is due to the longer duration of the infection in a geriatric population. In contrast to the toenail cases, the involvement of a thumbnail alone was 56.5% out of 62 cases of fingernail onychomycosis, and the involvement of 1~2 fingernails was in 69.3%. This finding was different from the report of Hwang et al.<sup>16</sup>, indicating that the involvement

of a thumbnail with other fingernails was prevailing.

DLSO type was found in 80.2% of the elderly patients as described by other reports<sup>4,16,21,26,27</sup>, followed by TDO (10.7%), SWO (6.2%) and PSO (2.9%) as observed by Hwang et al.<sup>16</sup> and Ahn et al.<sup>17</sup> No case for EO type was found. It should be noticed that TDO, a clinical type of onychomycosis newly added by Baran et al.<sup>28</sup> in 1998, has been increasing significantly in the adult and geriatric groups.

As described by Lim et al.<sup>21</sup>, dermatophytes were the most frequently isolated from 76.5% of the elderly onychomycosis, followed by yeasts from 14.3% and nondermatophytes 9.2%. It has been known that nondermatophytic molds become more frequently responsible for onychomycosis as the patient's age advances<sup>13</sup>. What we have found in this study agrees with this trend, but slightly higher than 6.5% reported by Lim et al.<sup>21</sup> Therefore, it is necessary to perform more accurate fungal tests when the elderly patients with onychomycosis are diagnosed. As described by other reports<sup>5,21,26,27</sup>, *T. rubrum* with 274 isolates was the most common fungus. *C. albicans* was the most common yeast with 25 isolates as seen in the report of Lim et al.<sup>21</sup> and followed by *C. parapsilosis* with 17 isolates. Among nondermatophytic molds, *A. niger* with 13 isolates outnumbered *A. fumigatus* with 9 isolates as described by Hwang et al.<sup>15</sup>, but differently from *A. fumigatus* prevalence over *A. niger* reported by Lim et al.<sup>21</sup>

Elderly patients are known to show poor response to the anti fungal therapy for onychomycosis, due to several risk factors such as frequent nail dystrophy, slow growth of nails, and increased prevalence of peripheral vascular disease and diabetes mellitus<sup>4</sup>. In general, itraconazole, terbinafine or fluconazole is prescribed for onychomycosis, and topical nail lacquers of 5% amorolfine or 8% cicloprox are available. Instead of monotherapy of

either oral or topical anti fungal agent, however, the combination of oral and topical agent is known to be highly effective<sup>4,16</sup>. In this study, the elderly patients with onychomycosis were mostly treated by the combination therapy of either itraconazole or terbinafine plus antifungal nail lacquer. For those with dermatophytoma showing poor response to the therapy, partial removal of nails involved was performed by using carbon dioxide laser as described by Lee et al.<sup>31</sup>, and then the combination therapy of an oral agent plus a nail lacquer was successfully tried.

In conclusion, onychomycosis has been increased in the elderly and there are many differences from other age groups in aspects of clinical features, associated diseases and etiologic agents. Therefore, we suggest the need of a careful mycological examination in the elderly patients with onychomycosis.

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