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Nail Digital Dermoscopy in Onychomycosis: A Correlation with Clinical Type, Gender, and Culture Examination

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ABSTRACT

Objective: Onychomycosis (OM) is a common disease that covers both tinea unguium and those remaining cases caused by yeasts, mainly of the *Candida* and various non-dermatophyte molds. Diagnosis is usually confirmed with direct microscopy and fungal culture. Nail dermoscopy is a non-invasive tool to diagnose various nail disorders and also to avoid time-consuming investigations. The aim of the present study was to determine the dermoscoping findings in OM and to correlate this with clinical type, gender, and culture results.

Materials and Methods: This was a cross-sectional study of 100 patients diagnosed with OM according to clinical findings and direct microscopic examination. Nail dermoscopy was performed using a FotoFinder Digital Dermoscope, and images were recorded. A part of the samples was cultured in all patients.

Results: The most frequent clinical type was distal lateral subungual onychomycosis (80.0%). The culture was negative in 72.0% of the samples. In the positive group, 48% of *Trichophyton rubrum* was cultured. The most common dermoscopic findings were longitudinal stria, ruin appearance, and longitudinal leukonychia. In culture-negative samples, irregular termination was most commonly seen. Ruin appearance, brown discoloration, hematoma, and transverse leukonychia, such as brushing, were compatible with total dystrophic OM.

Conclusion: Determinative dermoscopic findings for OM, clinical types, and fungus forms were identified. These signs can avoid unnecessary mycology in selected cases.

Keywords: Onychomycosis, dermoscopy, toenails, culture

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INTRODUCTION

Onychomycosis (OM) is one of the most common nail infective disorders, accounting for nearly 50% of patients who have nail disorders. It is a term that covers all fungal infections of the nail. Approximately 90% of most cases are caused by dermatophytes, especially *Trichophyton rubrum*, *Trichophyton mentagrophytes*, and *Epidermophyton floccosum*. The other 10% are developed by yeast or non-dermatophyte-type fungus. OM primarily affects adults between ages 30 and 60 years (1). Generally, the toenails are kept more than the fingernails. The nail bed, matrix, and nail plate that formed the nail unit may be involved particularly in OM, but the infection may have affected them all together (2). OM can be mimicking several diseases, such as psoriasis, lichen planus, alopecia areata, viral warts, chronic paronychia, traumatic onycholysis, and nail apparatus tumors (3). For this reason, diagnosing OM is extremely important. Direct microscopic examination with potassium hydroxide (KOH), fungal culture, histopathological evaluation, immunofluorescence examination with calcofluor white dye, enzyme analysis, and polymerase chain reaction can be used for diagnosing OM. The most commonly used conventional methods for diagnosis are direct microscopy and culture. However, the sensitivity and specificity of KOH examination and culture can vary from center to center (4). The other methods increase the sensitivity, but they are time-consuming, expensive, or invasive options for diagnosing OM (5, 6). Dermoscopy is a non-invasive diagnostic tool that is widely used for the diagnosis of melanocytic and non-melanocytic lesions and inflammatory and infectious diseases (7). Nail dermoscopy, also known as "onychoscopy," is a technique that aids clinical examination in the diagnosis of nail pigmentations; melanocytic and non-melanocytic tumors; and inflammatory, traumatic, and infectious diseases (8). It is substantial for avoiding unnecessary nail biopsies (9).

There are restricted studies guided by the diagnosis of OM with dermoscopy. The aim of the present study was to determine the most frequent dermoscopic patterns associated with OM and the correlation between fungus cultures and dermoscopic patterns in patients with a clinical diagnosis of OM.

MATERIALS and METHODS

This was a cross-sectional study. The study was approved by the Institutional Review Board (no. 2018/305).

Table 1. The mean age of the groups

Groups	Patients (n=100)		Controls (n=120)		t	p
	Mean	SD	Mean	SD		
Age	49.520	13.626	47.183	14.473	1.224	0.222

SD: Standard deviation

Informed consent was obtained from all participants of the study. Patients were admitted to the dermatology outpatient clinic of Selcuk University, Faculty of Medicine Hospital with a complaint of nail disturbance between June 2018 and November 2018. A total of 100 patients clinically and according to direct microscopic examination diagnosed with OM were included in the present study. KOH negative cases were excluded from the study. A part of the sample from direct microscopic examination (KOH 40%) was systematically performed for culture. Patients who used oral or topical antifungal therapy in the last 3 months; had diseases, such as psoriasis, lichen, eczema, autoimmune bullous diseases, and genodermatoses; and with nail involvement were excluded from the study. Age, gender, type of OM, limbs held, and number of nails were noted.

In all cases, one of the affected nails was examined by digital dermoscope (FotoFinder Dermoscope; FotoFinder Systems GmbH, Bad Birnbach, Germany) with a magnification of 20×. Higher magnification of up to 70× and unlimited manual magnification were used if necessary. The linkage fluid used was ultrasound gel in most of the cases. The photos were taken using Medicam 800 HD by FotoFinder Videodermoscope and recorded. Dermoscopy was performed to include the nail plate, nail plate free end, hyponeidia, and nail folds. A single observer analyzed each of the dermoscopy images to define the most common patterns and compare them with the patterns described by Piraccini et al. (10) and Kaynak et al. (11).

Statistical analysis: Data obtained in the study were analyzed using SPSS (Statistical Package for Social Sciences) for Windows 22.0 program (SPSS Inc., Chicago, IL, USA). Number, percentage, mean, and standard deviation were used as descriptive statistical methods in the evaluation of the data. The t-test was used to compare quantitative continuous data between two independent groups. The chi-square analysis was used to examine the relationship between group variables. The findings were evaluated at 95% confidence interval and 5% significance level.

RESULTS

The study included 100 patients with clinical suspicion and positive KOH examination of OM. Of the 100 patients, 66 (66.0%) were males, and 34 (34.0%) were females. The mean age of the patients was 49.52±13.62 years, and the mean age of the control group was 47.18±14.47 years. No significant difference was found between age and groups (p>0.05) (Table 1).

All patients had OM in the toenails. Of the 100 patients, 80 (80.0%) were clinically classified as distal lateral subungual OM (DLSO), 18 (18.0%) as total dystrophic OM (TDO), and 2 (2.0%) as white superficial OM (WSO).

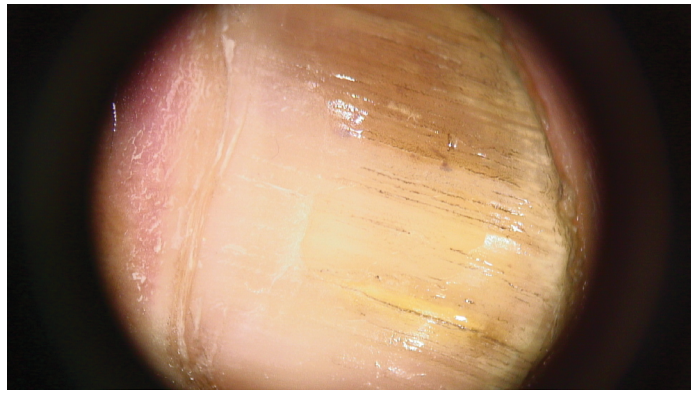


Figure 1. **Longitudinal striae which is whitish to brown in the onycholytic nail plate**

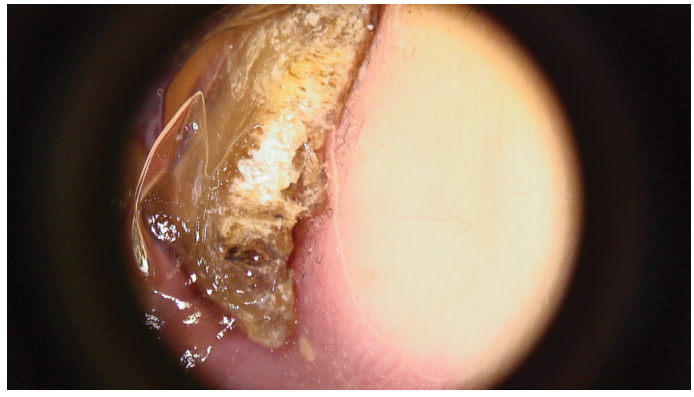


Figure 2. **Ruin appearancewhich means subungual hyperkeratosis and hematoma**

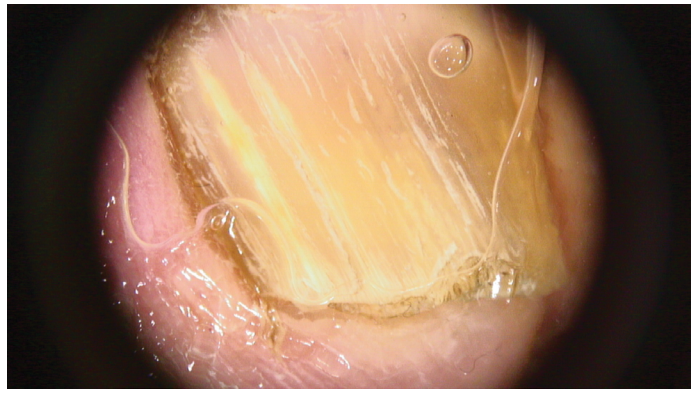


Figure 3. **Longitudinal leukonychia which is a white color change that extends parallel to the grooves in the nail plate**

The culture was negative in 42 (42.0%) samples. In 48 (48%) patients, *T. rubrum* was the causative agent, and in 10 (10%) patients, *Trichophyton tonsurans* was the causative agent.

In dermoscopy, longitudinal stria was seen as the most common pattern (66.0%) (Fig. 1). The second most common pattern was ruin appearance, meaning subungual hyperkeratosis (54.0%) (Fig. 2) (11). The incidence and distribution of other patterns are shown in Table 2 (Fig. 3–6).

The dermoscopic patterns were correlated with the clinical pattern of OM. A significant relationship was found between ruin

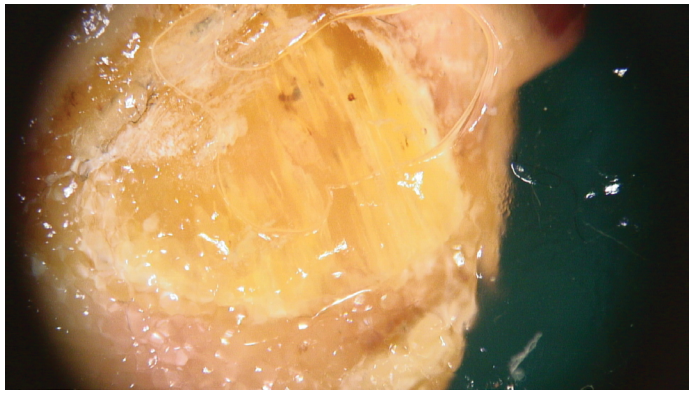


Figure 4. Punctate hemorrhages and transvers leukonychia such as brushing

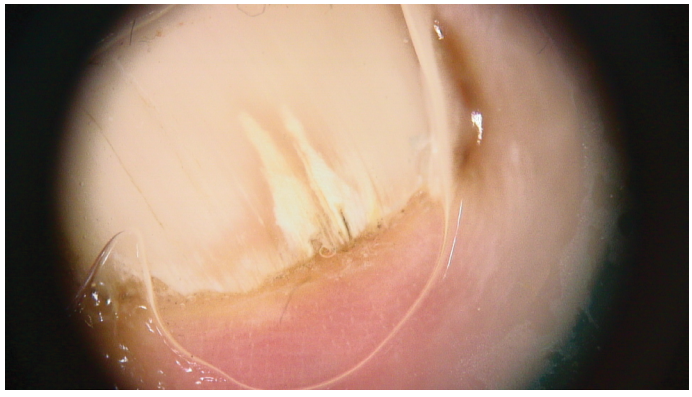


Figure 5. Jagged edge with spikes of the whitish longitudinal lines that seen in proximal side of the onycholytic area



Figure 6. Distal irregular termination which is the end of the thickened nail plate ending with an irregular

appearance and clinical type (X^2=6.960, p=0.031 <0.05). Ruin appearance was presented in 40 (50.0%) patients with DLSO type and 14 (77.8%) patients with TDO type. Furthermore, there was significance with punctate leukonychia (X^2=11.748, p=0.003 <0.05). It was seen in 10 (12.5%) patients with DLSO, 2 (10.0%) with WSO, and 4 (22.2%) with TDO. Brown discoloration was most commonly seen in TDO (55.6%). Punctate hemorrhage was found to be related with DLSO (27.5%). Hematoma was seen only in TDO (1.1%). Finally, transverse leukonychia, such as brushing, was clinically compatible with TDO (55.6%). The distribution of patterns according to clinical type is shown in Table 3.

Table 2. Distribution and percentage of clinical type, culture results, and dermoscopic patterns in patients

	Groups	Frequency n	Percentage %
Clinical pattern	DLSO	80	80.0
	WSO	2	2.0
	TDO	18	18.0
	Total	100	100.0
Culture	*T. rubrum*	48	48.0
	T. tonsurans	10	10.0
	Negative	42	42.0
	Total	100	100.0
Dermoscopic patterns	Ruin appearance	54	54.0
	Longitudinal stria	66	66.0
	Jagged edge with spikes	6	6.0
	Distal irregular termination	20	20.0
	Homogenous leukonychia	28	28.0
	Punctate leukonychia	16	16.0
	Longitudinal leukonychia	30	30.0
	Black discoloration	10	10.0
	Brown discoloration	22	22.0
	Splinter hemorrhage	8	8.0
	Punctate hemorrhages	22	22.0
	Hematoma	2	2.0
	Transverse leukonychia, such as brushing	2	2.0

DLSO: Distal lateral subungual OM; WSO: White superficial OM; TDO: Total dystrophic OM

Then, the dermoscopic patterns were correlated with gender. Punctate leukonychia pattern was seen especially in females (29.4%) (X^2=6.895, p=0.011 <0.05), black discoloration pattern in males (15.2%) (X^2=5.724, p=0.012 <0.05), and transverse leukonychia, such as brushing, in males (30.3%) (X^2=4.228, p=0.032 <0.05) (Table 4).

Finally, the dermoscopic patterns were tried to be correlated with the culture results. Distal irregular termination was most commonly seen in culture-negative samples (33.3%) (X^2=8.750, p=0.013 <0.05), longitudinal leukonychia in *T. rubrum* positive samples (41.7%) (X^2=8.163, p=0.017 <0.05), and black discoloration in culture-negative samples (19.0%), and it was not seen in *T. tonsurans* positive patients (100.0%) (X^2=6.746, p=0.034 <0.05). Punctate hemorrhage was almost seen in *T. tonsurans* positive cultures (60.0%) (X^2=9.424, p=0.009 <0.05) (Table 5).

Table 3. The distribution of patterns according to clinical type

	DLSO		WSO		TDO		p
	n	%	n	%	n	%	
Ruin appearance							
Positive	40	50.0	0	0.0	14	77.8	X^2=6.960
Negative	40	50.0	2	100.0	4	22.2	p=0.031
Longitudinal stria							
Positive	56	70.0	0	0.0	10	55.6	X^2=5.328
Negative	24	30.0	2	100.0	8	44.4	p=0.070
Jagged edge with spikes							
Positive	6	7.5	0	0.0	0	0.0	X^2=1.596
Negative	74	92.5	2	100.0	18	100.0	p=0.450
Distal irregular termination							
Positive	14	17.5	0	0.0	6	33.3	X^2=2.813
Negative	66	82.5	2	100.0	12	66.7	p=0.245
Homogenous leukonychia							
Positive	20	25.0	2	100.0	6	33.3	X^2=5.754
Negative	60	75.0	0	0.0	12	66.7	p=0.056
Punctate leukonychia							
Positive	10	12.5	2	100.0	4	22.2	X^2=11.748
Negative	70	87.5	0	0.0	14	77.8	p=0.003
Longitudinal leukonychia							
Positive	22	27.5	0	0.0	8	44.4	X^2=2.884
Negative	58	72.5	2	100.0	10	55.6	p=0.237
Black discoloration							
Positive	6	7.5	0	0.0	4	22.2	X^2=3.765
Negative	74	92.5	2	100.0	14	77.8	p=0.152
Brown discoloration							
Positive	12	15.0	0	0.0	10	55.6	X^2=14.659
Negative	68	85.0	2	100.0	8	44.4	p=0.001
Splinter hemorrhage							
Positive	8	10.0	0	0.0	0	0.0	X^2=2.174
Negative	72	90.0	2	100.0	18	100.0	p=0.337
Punctate hemorrhages							
Positive	22	27.5	0	0.0	0	0.0	X^2=7.051
Negative	58	72.5	2	100.0	18	100.0	p=0.029
Hematoma							
Positive	0	0.0	0	0.0	2	11.1	X^2=9.297
Negative	80	100.0	2	100.0	16	88.9	p=0.010
Transverse leukonychia, such as brushing							
Positive	14	17.5	0	0.0	10	55.6	X^2=12.311
Negative	66	82.5	2	100.0	8	44.4	p=0.002

DLSO: Distal lateral subungual OM; WSO: White superficial OM; TDO: Total dystrophic OM

DISCUSSION

Our data demonstrate that dermoscopic patterns of OM showed the following frequencies: longitudinal stria, ruin appearance, longitudinal leukonychia, homogenous leukonychia, and transverse leukonychia, such as brushing. Longitudinal stria was more frequently observed in patients with DLSO, homogenous

Table 4. The distribution of dermoscopic patterns to gender

	Males		Females		p
	n	%	n	%	
Ruin appearance					
Positive	40	60.6	14	41.2	X^2=3.410
Negative	26	39.4	20	58.8	p=0.051
Longitudinal stria					
Positive	46	69.7	20	58.8	X^2=1.182
Negative	20	30.3	14	41.2	p=0.193
Jagged edge with spikes					
Positive	2	3.0	4	11.8	X^2=3.035
Negative	64	97.0	30	88.2	p=0.100
Distal irregular termination					
Positive	16	24.2	4	11.8	X^2=2.184
Negative	50	75.8	30	88.2	p=0.110
Homogenous leukonychia					
Positive	16	24.2	12	35.3	X^2=1.360
Negative	50	75.8	22	64.7	p=0.176
Punctate leukonychia					
Positive	6	9.1	10	29.4	X^2=6.895
Negative	60	90.9	24	70.6	p=0.011
Longitudinal leukonychia					
Positive	22	33.3	8	23.5	X^2=1.027
Negative	44	66.7	26	76.5	p=0.218
Black discoloration					
Positive	10	15.2	0	0.0	X^2=5.724
Negative	56	84.8	34	100.0	p=0.012
Brown discoloration					
Positive	16	24.2	6	17.6	X^2=0.569
Negative	50	75.8	28	82.4	p=0.313
Splinter hemorrhage					
Positive	4	6.1	4	11.8	X^2=0.992
Negative	62	93.9	30	88.2	p=0.266
Punctate hemorrhages					
Positive	14	21.2	8	23.5	X^2=0.070
Negative	52	78.8	26	76.5	p=0.490
Hematoma					
Positive	2	3.0	0	0.0	X^2=1.051
Negative	64	97.0	34	100.0	p=0.433
Transverse leukonychia, such as brushing					
Pozitif	20	30.3	4	11.8	X^2=4.228
Negative	46	69.7	30	88.2	p=0.032

leukonychia in WSO, and ruin appearance and brown discoloration in TDO. In addition to other similar studies, the correlation between gender and culture results with dermoscopic patterns was also investigated.

Dermoscopy plays an important role to ease the diagnosis of dermatological disorders as it is a non-invasive procedure (7). The use of a dermoscope in OM has been first performed by Piraccini et al. (10). They studied the difference between DLSO and traumatic onycholysis. According to their study, two patterns, jagged proximal edge with spikes of the onycholytic area and longitudinal striae, had been presented in DLSO and only one pattern, linear edge without spikes, in traumatic onycholysis. In our study, jagged proximal edge with spikes had been presented in 6% of patients with OM, and all of them had DLSO as clinical type; longitudinal striae were 66.0% and 70.0% in DLSO and 55.6% in TDO. The rate of longitudinal striae was similar, but the rate of jagged edge with spikes was lower in our study. In culture results, longitudinal stria was the most frequent in *T. tonsurans* positive samples (80.0%).

Nakamura et al. performed dermoscopy in 500 cases of nail dystrophies and found chromonychia, onycholysis, opacity, and longitudinal stripes in patients with OM (1). In another study with onychoscopy in 237 patients with nail disorder, OM showed jagged pattern of the proximal margin of the onycholytic area, spikes in the proximal fold, white-yellow longitudinal striae in the onycholytic nail plate, and distal irregular termination pattern (12).

Similar to our study, Jesus-Silva et al. found that TDO (56.13%) is the most common clinical pattern in OM, and that longitudinal striae pattern (32.9%) is the most common dermoscopic pattern. In addition, they described a pattern as distal irregular termination in TDO and DLSO samples (13). It means "the end of the thickened nail plate ending with an irregular and crumbly appearance" (11). Its frequency was found in 20% of patients with OM, and it was more common in DLSO type (17.5%) and culture-negative samples (33.3%).

In a case control study, spikes, longitudinal striations, and color changes were statistically significantly higher in patients than in controls. They found that the sensitivity of spikes in OM was 100% and that of longitudinal striations was 82.5%, and color changes were not only seen in OM but also seen in healthy controls (14). This was consistent with what Piraccini et al. stated (10). Kaynak et al. diagnosed 205 patients with DLSO and found that longitudinal striae pattern is observed in 79.5% of the samples, and that jagged edge with spikes pattern is observed in 63.4% of the samples. At the end of the study, they suggested that ruin appearance and punctate leukonychia are identified as dermoscopic patterns with high sensitivity only for DLSO diagnosis (11). In another study by Nargis et al., longitudinal striae and jagged proximal edges were seen in all patients, intermittent spiked pattern was seen in 78.3% of patients, and chromonychia and distal irregular termination were noticed in 38.3% and 11.7% patients, respectively (15). Nail unit pathology reported that 52 patients with abnormal great toenails were compared with the dermoscopic features detected by nail unit dermoscopy in Bodman's study. The specific dermoscopic findings of short spikes ($p<0.001$), long striae ($p<0.001$), aurora borealis ($p<0.001$), irregular termination ($p=0.003$), dermatophytoma ($p=0.011$), transverse onycholysis ($p=0.018$), and dry scale ($p=0.04$) patterns were all significantly associated with pathology test results consistent with OM. Transverse onycholysis ($p=0.018$) was significantly associated with negative pathology results consistent with the diagnosis of nail dystrophy (16).

Table 5. The distribution of dermoscopic patterns by type of culture

	T. rubrum		*T. tonsurans*		Culture (-)		p
	n	%	n	%	n	%	
Ruin appearance							
Positive	28	58,3	4	40,0	22	52,4	X^2=1,196
Negative	20	41,7	6	60,0	20	47,6	p=0,550
Longitudinal stria							
Positive	26	54,2	8	80,0	32	76,2	X^2=5,812
Negative	22	45,8	2	20,0	10	23,8	p=0,055
Jagged edge with spikes							
Positive	6	12,5	0	0,0	0	0,0	X^2=6,915
Negative	42	87,5	10	100,0	42	100,0	p=0,032
Distal irregular termination							
Positive	4	8,3	2	20,0	14	33,3	X^2=8,750
Negative	44	91,7	8	80,0	28	66,7	p=0,013
Homogenous leukonychia							
Positive	14	29,2	2	20,0	12	28,6	X^2=0,357
Negative	34	70,8	8	80,0	30	71,4	p=0,837
Punctate leukonychia							
Positive	6	12,5	2	20,0	8	19,0	X^2=0,847
Negative	42	87,5	8	80,0	34	81,0	p=0,655
Longitudinal leukonychia							
Positive	20	41,7	0	0,0	10	23,8	X^2=8,163
Negative	28	58,3	10	100,0	32	76,2	p=0,017
Black discoloration							
Positive	2	4,2	0	0,0	8	19,0	X^2=6,746
Negative	46	95,8	10	100,0	34	81,0	p=0,034
Brown discoloration							
Positive	12	25,0	0	0,0	10	23,8	X^2=3,152
Negative	36	75,0	10	100,0	32	76,2	p=0,207
Splinter hemorrhage							
Positive	4	8,3	2	20,0	2	4,8	X^2=2,562
Negative	44	91,7	8	80,0	40	95,2	p=0,278
Punctate hemorrhages							
Positive	8	16,7	6	60,0	8	19,0	X^2=9,424
Negative	40	83,3	4	40,0	34	81,0	p=0,009
Hematoma							
Positive	2	4,2	0	0,0	0	0,0	X^2=2,211
Negative	46	95,8	10	100,0	42	100,0	p=0,331
Transverse leukonychia, such as brushing							
Positive	10	20,8	2	20,0	12	28,6	X^2=0,833
Negative	38	79,2	8	80,0	30	71,4	p=0,659

In our study, longitudinal stria and punctate hemorrhage were identified as dermoscopic patterns with high sensitivity for DLSO; ruin appearance, longitudinal leukonychia brown discoloration, and transverse leukonychia, such as brushing, for TDO; and homogenous leukonychia for WSO. This finding suggests that if these patterns are detected in cases with uncertainty of OM, they can guide us. Again, in the same way, jagged edge with spikes and longitudinal leukonychia can be strongly associated with fungi and punctate hemorrhage pattern of samples showing high *T. tonsurans* reproduction probability in culture.

The limitations of our study include a small sample size of the study group selection that does not reflect the general population at a single clinic. Second, there was no control group to compare. In addition to this, our study was a prospective study, used digital dermoscopy in determining dermoscopic patterns, and in contrast to other studies, dermoscopic patterns were also correlated with culture results and gender.

In summary, the diagnosis of OM cannot be built trusting on the clinical appearance alone. There is a need for a supportive diagnostic tool. Nail dermoscopy is an easy, quick, non-invasive and cost-effective tool to showing the OM changes when mycology is not available. Further studies with large samples will confirm these dermoscopic patterns in OM and will compare these findings with other nail diseases.

Ethics Committee Approval: Selçuk University Faculty of Medicine Non-interventional Clinical Research Ethics Committee. Number: 2018/305 Date: 12.09.2018.

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

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Conflict of Interest: The authors have no conflict of interest to declare.

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