Dermoscopic Criteria of Nail Changes in Onychomycosis

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Abstract: Background: Onychomycosis is one of the most common nail disorders (50 % cases). Accurate diagnosis is important since the treatment can be long-standing and expensive and may be accompanied by severe adverse effects. The diagnosis is made by clinical suspicion along with KOH examination followed by culture of the sample. This method may be uncomfortable and even painful for the patient and may vary significantly when performed by an experienced mycologist with proper sampling technique. Digital dermoscopy, also called onychoscopy is a complementary tool which aids in the diagnosis of nail diseases more quickly and can also be used for monitoring the evolution, therapeutic response and prognosis of these diseases. **Objectives:** To describe dermoscopic nail changes in onycomycosis, aiming to help clinicians to easily diagnose onychomycosis. **Methods:** 30 patients were included in this study. Each patient was subjected to: 1) Full history taking, 2) Clinical examination, 3) Mycological study (direct microscopy: 20% KOH/40% DMSO to verify presence of fungi and culture: on SDA to identify suspected fungi, 4) Digital photographic imaging for the diseased nail and 5) Dermoscopic imaging for the diseased nail. **Results:** There were 4 confirmatory dermoscopic features to diagnose onycomycosis: Longitudinal striations, spikes, distal irregular termination (and/or) aurora borealis. There was significant difference between clinical types of onychomycosis regarding longitudinal striations (p= 0.001*) and spikes (p=0.01*), defining that longitudinal striations and spikes are more common in DLSO, TDO. It was noticeable that P value for aurora borealis is 0.05. Positive cultures yielded yeast species in 12 (40.0%), mixed (yeast and mold) in 6 (20.0%), mold species in 4 (13.3%) and dermatophyte species in 2 (6.7%).
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1. Introduction

Dermoscopy is a non-invasive tool that is largely recognized and used in the diagnosis of pigmented and non-pigmented skin tumors. A steadily increasing number of publications on alternative applications of dermoscopy suggest that dermoscopy aids also the recognition of skin manifestations in general dermatology **(Zalaudek et al., 2013).**

Dermoscopy, also known as dermatoscopy, epiluminescence microscopy, incident light microscopy, or skin surface microscopy, is performed using a handheld instrument called a dermatoscope or dermoscope, which has a transilluminating light source and standard magnifying optics (10×). The dermatoscope facilitates visualization of subsurface skin structures located within the epidermis, dermoepidermal junction, and papillary dermis, which are otherwise not visible to the unaided eye **(Argenziano and Soyer, 2001).**

The increasing use of dermoscopy in general dermatology can be partially explained by commercially available new generations of handheld dermoscopes, which are small enough to be easily placed in every dermatologist's pocket. Moreover, some devices do not require direct contact between the patient's skin and the optical glass plate, thus enabling a rapid and safe examination without the risk of possible transfection **(Zalaudek et al., 2013).**

The diagnostic accuracy of dermoscopy has been reported to be at least equal to traditional ex vivo microscopic examination, while requiring less time, cost and experience **(Walter et al., 2011; Park et al., 2012).**

2. Patients and Methods

This study was carried out at the Dermatology and Venereology Depratment, Al Hussien University Hospitals. It included 30 patients presented with onychomycosis.

Patients

Inclusion criteria:

Patients with clinical and mycological diagnosis of onychomycosis.

Exclusion criteria:

Patients with other nail disorders eg., psoriasis, lichen planus.

Patients who have used topical antifungal treatment in the last two weeks or systemic antifungal treatment in the last three months.

Methods

Every patient was subjected to:

1- Full history taking: including demographic data, medical history and history of previous treatment.

2- Clinical evaluation:

To determine the type of onychomycosis and to exclude other nail disorders.

3.- Mycological study: according to the type of onychomycosis and after cleaning the selected area (s) with alcohol, duplicate sets of nail scrapings were collected from the sites of infection and examined by direct microscopy and culture.

Direct microscopy:

One set of nail scrapings was treated with a solution made from mixture of 20% KOH and dimethyl sulfoxide (DMSO) to help rule out or more easily verify the presence of fungi.

Culture:

The second set of scrapings was inoculated on Sabouraud's dextrose agar (SDA) to identify suspected dermatophytes. Samples were inoculated onto two types of culture media: SDA with cycloheximide (to suppress the growth of contaminant fungi) and SDA without cycloheximide. Chloramphenicol was added to both culture media (to prevent bacterial overgrowth). The media were then incubated in a warm, moist environment at 28°C and examined regularly to detect growth of any fungus. Observation for growth was done periodically for at least 4 weeks after which the media reported as positive or negative.

4- Digital photographic imaging for the diseased nails:

Images were obtained using a digital camera (FUJIFILM FinePix JX260, 5× optical zoom, 14.0 Megapixels; FUJIFILM Corporation, Tokyo, Japan). For each patient, several different images were taken and evaluated.

5- Digital dermoscopic imaging:

The dermoscopy used in this study was Dermlite II PRO HR (3 Gen Inc., San Juan Capistrano, California, USA), which is palm sized, offers high light output, has a large 25mm lens, camera adaptability, as well as an integrated rechargeable lithium ion battery. The unit is equipped with a retractable faceplate spacer. As regards the light intensity, a push button is used to toggle between two light intensity settings. The first mode activates 16 LEDs and the second activates 32 LEDs. Ultrasound gel was applied on the affected nail before examination and then the dermoscope was applied with a space of about 1mm between it and the nail, and the magnification power was 10× ***(Figure 4).***

Figure 4. Dermlite II PRO HR

Statistical Analysis

Data were checked, entered and analyzed by using SPSS version 15. Data are expressed as mean ± SD for quantitative variables, number and percentage for categorical variables. Chi square (X2), T-test or Fisher Exact test are used when appropriate.

The probability (p) is then obtained for (X2) distribution tables according to a certain degree of freedom (d.f).

- P- value: level of significance.
- P>0.05: Non significant (NS).
- P< 0.05: Significant (S).

3. Results

This study included 30 patients with onychomycosis, the collected data was presented and suitable analysis was done according to the type of data obtained for each parameter.

Distribution of age and sex:

There were 6 males (20%) and 24 females (80%). Age of patients ranged from 5 to 65 years (mean 35.2 ± SD 16.6) **(Table10, Figure 5).**

Table 10: Distribution of age and sex

		Mean	±SD	Min.	Max.
Age		35.2	16.6	5.00	65.00
Sex	Male (n %)	6	20.0%		
	Female (n %)	24	80.0%		

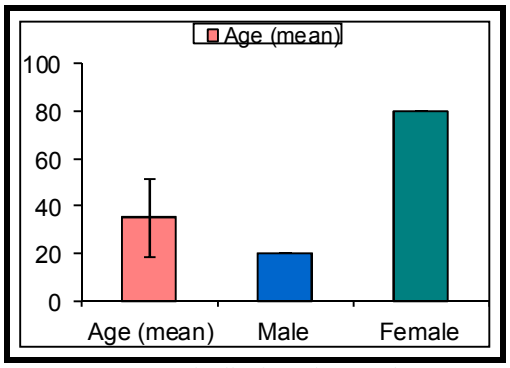


Figure 5: Distribution of age and sex

Distribution of nail affection

Out of the total number of patients, the number of patients with affected fingernails were 17 (56.7%) and the number of patients with affected toenails were 13 (43.3%) **(Table 11, Figure 6).**

Table 11: Distribution of nail affection

	N	%
Fingernail	17	56.7
Toenail	13	43.3

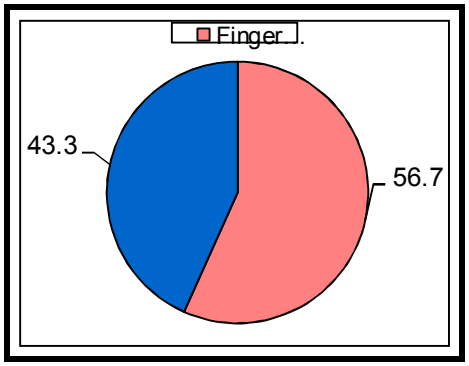


Figure 6: Distribution of nail affection

Clinical types of onychomycosis

Clinically, 25 patients had DLSO (83.4%) **(Figure 20, 21)**, 4 patients had TDO (13.3%) **(Figure 22)** and 1 patient had WSO (3.3%) **(Table 12, Figure 7).**

Table 12: Clinical types of onychomycosis

Type of onychomycosis	N	%
DLSO	25	83.4
TDO	4	13.3
WSO	1	3.3

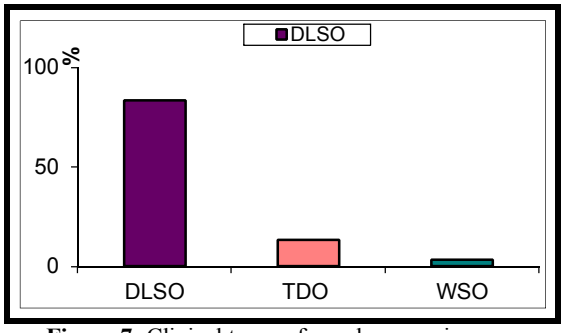


Figure 7: Clinical types of onychomycosis

Relation between age of the patients and type of nail affection

There was no significant difference between fingernail and toenail cases regarding the age the patients (P=0.59) **(Table 13, Figure 8).**

Table 13: Relation between age of patients and type of nail affection

		Age						
		N	Mean	±SD	Minimum	Maximum	t	p
Site of nail affection	Fingernail	17	33.7	17.1	5.00	65.00	0.54	0.59
	Toenail	13	37.1	16.6	7.00	62.0		

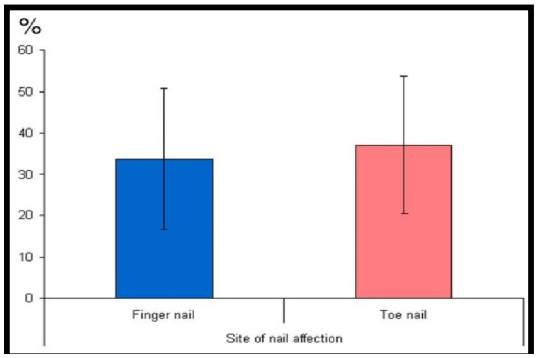


Figure 8: Relation between age of patients and type of nail affection

Relation between sex of patients and type of nail affection

There was significant difference between male and female cases regarding type of nail affection (P=0.018*), defining that toenail affection was more common in females **(Table 14, Figure 9).**

Clinical and mycological results

The collected data from clinical and mycological examination of all patients regarding, age, sex, distribution of nail affection, type of onychomycosis, KOH, culture and nail color are presented in **Table 15.**

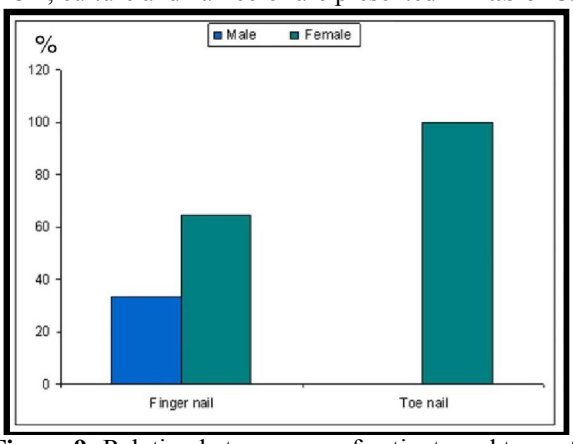


Figure 9: Relation between sex of patients and type of nail affection

Table 14: Relation between sex of patients and type of nail affection

		Type of nail affection				X2	p
		Fingernail		Toenail			
		N	%	N	%		
Sex	Male	6	33.3	0	0.0	5.54	0.018*
	Female	11	64.7	13*	100.0		

Table 15: Clinical and mycological results.

Case N	Age	Sex	Fingernail	Toenail	Type of onychomycosis	KOH	Culture		Nail Color				
							With cycloheximide	Without cycloheximide	White	Yellow	Orange	Brown	Gray black
1	47	F		+	DLSO	+ve	-ve	-ve		+			
2	53	F		+	DLSO	+ve	-ve	-ve		+			
3	24	M	+		DLSO	+ve	-ve	-ve	+	+		+	
4	26	M	+		DLSO	+ve	-ve	-ve	+	+		+	+
5	24	F	+		DLSO	+ve	Mold sp	Mold sp		+			
6	40	F		+	DLSO	+ve	-ve	Trichosporumsp; Yeastsp		+			
7	13	F	+		DLSO	+ve	-ve	Penicilliumsp; Asperagillussp		+			
8	30	M	+		DLSO	+ve	-ve	Trichosporumsp; Yeastsp	+		+		
9	62	F		+	DLSO	+ve	Rhodotorulasp	Rhodotorulasp; Asperagillussp		+		+	+
10	60	F		+	DLSO	+ve	Yeast sp	Yeast sp		+			
11	65	M	+		DLSO	+ve	-ve	-ve		+			
12	47	F		+	DLSO	+ve	-ve	Mold sp	+			+	
13	36	F	+		TDO	+ve	Trichophytonviolaceum	Trichophytonviolaceum	+	+		+	+
14	20	F		+	DLSO	+ve	-ve	Trichosporumsp; Yeast sp		+			
15	5	M	+		TDO	+ve	Yeast sp	Yeast sp	+				
16	21	F		+	DLSO	+ve	Yeast sp	Yeast sp	+		+	+	
17	24	F	+		DLSO	+ve	Yeast sp	Asperagillussp		+		+	+
18	60	F	+		DLSO	+ve	Mold sp	Mold sp		+	+		
19	55	M	+		DLSO	+ve	-ve	Yeast sp;Asperagillussp		+			
20	25	F	+		DLSO	+ve	Yeast sp	Yeast sp	+	+			
21	30	F	+		DLSO	+ve	-ve	Trichosorumsp		+			
22	31	F	+		DLSO	+ve	-ve	Mold sp; Yeast sp		+			
23	7	F		+	TDO	+ve	-ve	-ve		+		+	
24	27	F		+	WSO	+ve	Trichosorumsp	Trichosporumsp	+			+	
25	40	F		+	DLSO	+ve	Rhodotorulasp;Asperagillussp	Rhodotorulasp;Asperagillussp	+	+		+	
26	61	F	+		DLSO	+ve	-ve	Yeast sp		+	+	+	+
27	26	F	+		DLSO	+ve	Yeast sp	Yeast sp		+			
28	38	F	+		TDO	+ve	Yeast sp	Yeast sp		+		+	
29	30	F		+	DLSO	+ve	Trichophytonrubrum	Trichophytonrubrum		+		+	
30	28	F		+	DLSO	+ve	Rhodotorulasp	Asperagillussp		+	+		

Distribution of the diagnostic dermoscopic signs

The percent of the diagnostic dermoscopic signs were longitudinal striations (longitudinal striae of different colors in the onycholytic nail plate) 93.3% **(Figure 23, 24)**, spikes (proximal margin of the onycholytic area showing jagged edge, with sharp structures, directed to the proximal fold) 90.0% **(Figure 25)**, distal irregular termination (indentate areas on the ventral portion of the nail, ruin appearance,) 80.0% **(Figure 26)** and aurora borealis (the appearance of the color of the affected nail plate in a matted variable discoloration) 26.7% **(Figure 27) (Table 16 & 17 and Figure 10).**

Table 16: Nail dermoscopic signs

	Spikes	Longitudinal striations	Distal irregular termination	Aurora borealis
1	+	+	+	
2	+	+	+	
3	+	+		
4	+	+	+	+
5	+	+	+	
6	+	+	+	
7	+	+	+	
8	+	+		
9		+	+	
10	+	+	+	
11				
12	+	+	+	+
13	+	+		+
14	+	+	+	
15	+	+	+	
16	+	+	+	
17	+	+	+	+
18	+	+	+	
19	+	+	+	
20	+	+	+	
21	+	+	+	
22	+	+	+	
23	+	+	+	+
24			+	
25	+	+	+	+
26	+	+		+
27	+	+		
28	+	+	+	+
29	+	+	+	
30	+	+	+	

Table 17: Distribution of the diagnostic dermoscopic signs

Sign	Findings	N	%
Longitudinal striations	present	28	93.3
	Absent	2	6.7
Spikes	Present	27	90.0
	Absent	3	10.0
Distal irregular termination	Present	24	80.0
	Absent	6	20.0
Aurora borealis	Absent	22	73.3
	Present	8	26.7

Distribution of dermoscopic findings of nails

Nail pigmentation was present in 26 cases (86.7%). Nail color was abnormal in 30 cases (100%). Nail plate thinning was present in 1 case (3.3%). Nail plate thickening was present in 27 cases (90.0%). Splinter haemorrage was present in 5 cases (16.7%). Transverse overcurvature was present in 3 cases (10.0%). Subungual hyperkeratosis was present in 25 cases (83.3%). Nail plate onycholysis was present in 8 cases (26.7%).

The lateral nail fold was scaly in 24 cases (80.0%) and was inflamed in 5 cases (16.7%). Proximal nail fold was abnormal in 25 cases (83.3%). Cuticle was abnormal in 20 cases (66.7%), normal in 5 cases (16.7%) and absent in 5 cases (16.7%). Surrounding skin was scaly in 24 cases (80.0%) and inflamed in 6 cases (20.0%). Distal edge of nail plate was irregular in 24 cases (80.0%) and linear in 6 cases (20.0%). Hyponychium was scaly in 30 cases (100.0%). Lunula was lost in 23 cases (76.7%) **(Table 18 & 19 and Figure 11).**

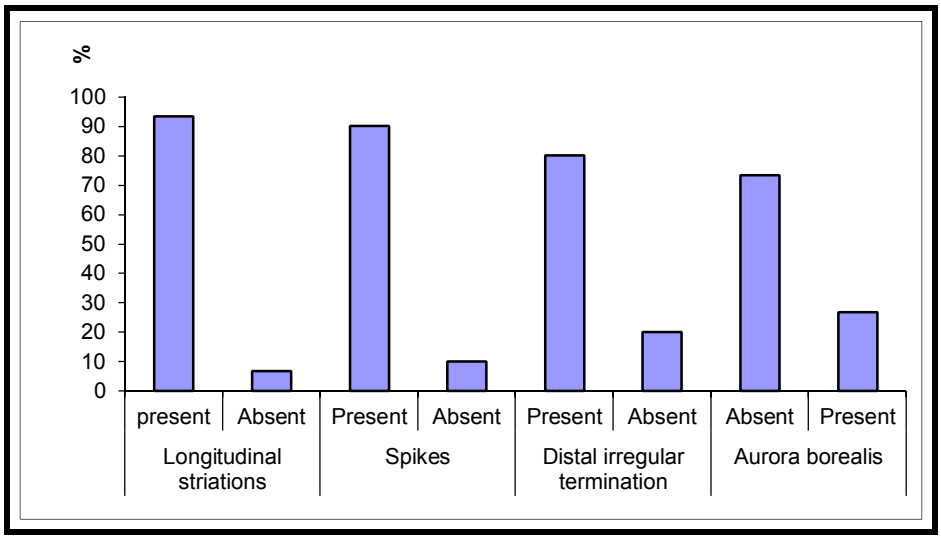


Figure 10: Distribution of the diagnostic dermoscopic signs

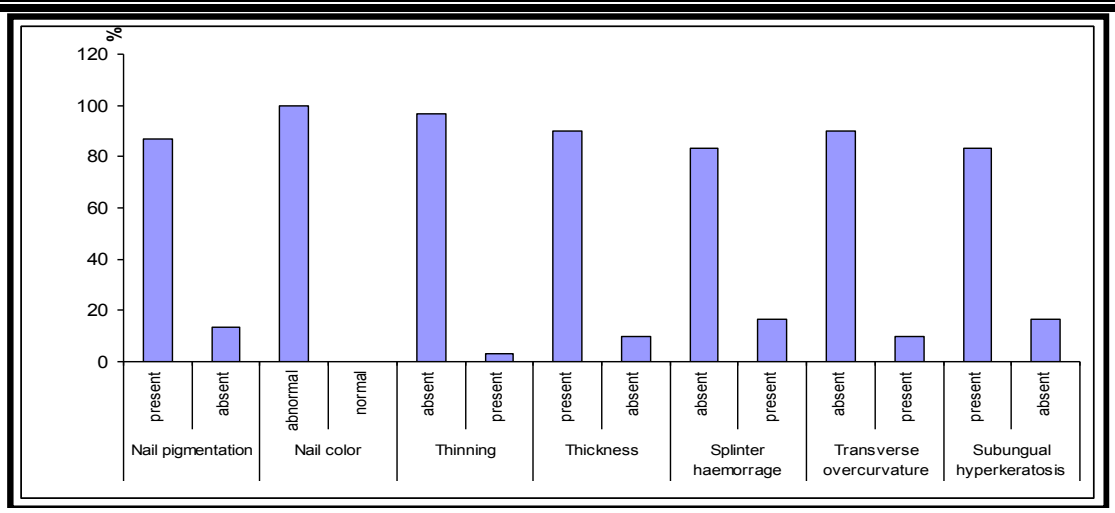
Table 18: Details of dermoscopic findings of nails in all studied patients

Sign/Site	Findings	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Nail pigmentation	absent	+	+			+																+								
	present			+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+
Nail color	normal																														
	abnormal	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Thinning	absent	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	present					+																									
Thickness	absent					+						+																+			
	present	+	+	+	+		+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+
Splinter haemorrage	absent	+	+	+	+	+	+	+	+		+	+		+	+			+	+	+	+	+	+		+	+	+	+	+	+	+
	present									+			+			+	+							+							
Transverse overcurvature	absent	+	+	+		+	+	+	+		+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	present				+					+				+																	
Subungual hyperkeratosis	absent							+				+			+				+				+							
	present	+	+	+	+	+	+		+	+	+		+	+		+	+	+		+	+	+		+	+	+	+	+	+	+	+
Onycholysis	absent		+	+		+	+	+	+		+	+	+		+	+	+		+	+	+		+	+	+	+	+		+	+	
	present	+			+					+				+				+				+						+			+
Lateral nail fold	normal			+																											
	scaly	+	+		+	+	+		+		+	+	+		+		+	+	+	+		+	+	+	+	+	+	+	+	+	+
	inflammed							+		+				+		+					+										
Proximal nail fold	normal		+	+	+			+																			+				
	abnormal	+				+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+
Cuticle	normal		+	+	+			+													+										
	abnormal	+					+		+		+	+	+				+	+	+	+		+	+	+	+	+	+	+	+	+	+
	absent					+				+				+	+	+															
Surrounding skin	scaly	+	+		+	+	+		+		+	+	+		+		+	+	+	+		+	+	+	+	+	+	+	+	+	+
	inflammed			+				+		+				+		+					+										
Distal edge of nail plate	regular			+					+			+		+													+	+			
	irregular	+	+		+	+	+	+		+	+		+		+	+	+	+	+	+	+	+	+	+	+	+			+	+	+
Hyponychium	normal																														
	scaly	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Lunula	normal		+		+							+							+		+		+				+				
	lost	+		+		+	+	+	+	+	+		+	+	+	+	+	+		+		+		+	+	+		+	+	+	+

Table 19: Distribution of dermoscopic findings of nails

Sign/Site	Findings	N	%
Nail pigmentation	present	26	86.7
	absent	4	13.3
Nail color	abnormal	30	100.0
	normal	0	00.0
Thinning	absent	29	96.7
	present	1	3.3
Thickness	present	27	90.0
	absent	3	10.0
Splinter haemorrage	absent	25	83.3

	present	5	16.7
Transverse overcurvature	absent	27	90.0
	present	3	10.0
Subungual hyperkeratosis	present	25	83.3
	absent	5	16.7
Onycholysis	absent	22	73.3
	present	8	26.7
Lateral nail fold	scaly	24	80.0
	inflammed	5	16.7
	normal	1	3.3
Proximal nail fold	abnormal	25	83.3
	normal	5	16.7
Cuticle	abnormal	20	66.7
	normal	5	16.7
	absent	5	16.7
Surrounding skin	scaly	24	80.0
	inflammed	6	20.0
Distal edge of nail plate	irregular	24	80.0
	regular	6	20.0
Hyponychium	scaly	30	100.0
	normal	0	00.0
Lunula	absent	23	76.7
	present	7	23.3



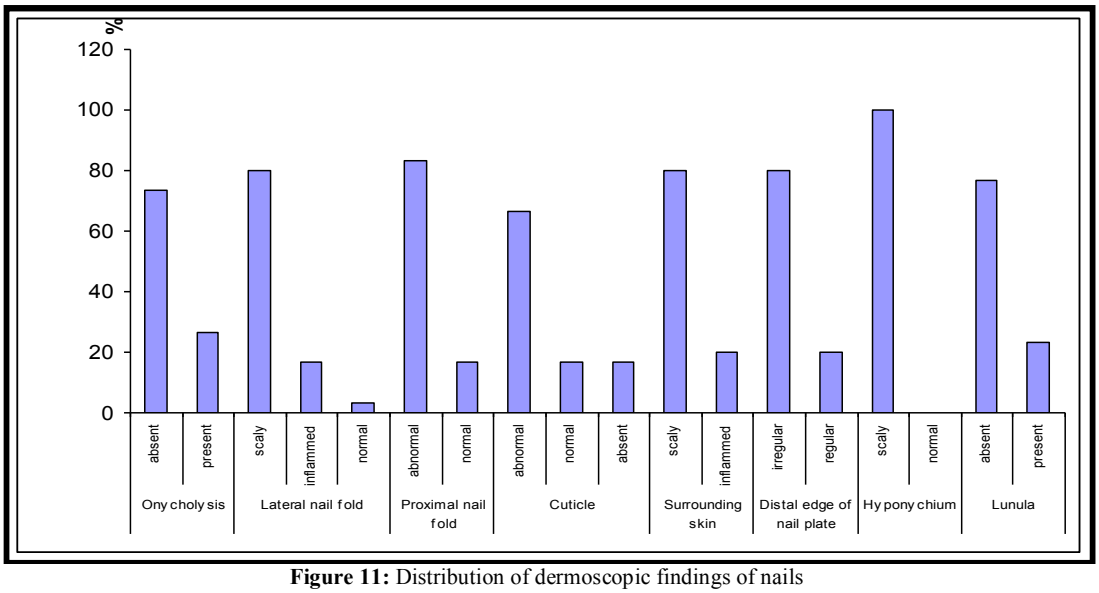


Figure 11: Distribution of dermoscopic findings of nails

Relation between the different clinical types of onychomycosis and dermoscopic pattern

There was significant difference between clinical types of onychomycosis regarding longitudinal striations (p= 0.001*) and spikes (p=0.01*), defining that longitudinal striations and spikes are more common in DLSO, TDO. It is noticeable that P value for aurora borealis is 0.05 **(Table 20 and Figure 12).**

Table 20: Relation between the different clinical types of onychomycosis and dermoscopic pattern

Types of onychomycosis		DLSO		TDO		WSO		X2	P
		N	%	N	%	N	%		
		25	100.0	4	100.0	1	100.0		
Dermoscopic pattern	Longitudinal striations	24	96.0	4	100.0	0	0.0	14.5	0.001*
	Spikes	23	92.0	4	100.0	0	0.0	9.5	0.01*
	Distal irregular termination	20	80.0	3	75.0	1	100.	0.3	0.8
	Aurora borealis	5	20.0	3	75.0	0	0.0	5.7	0.05

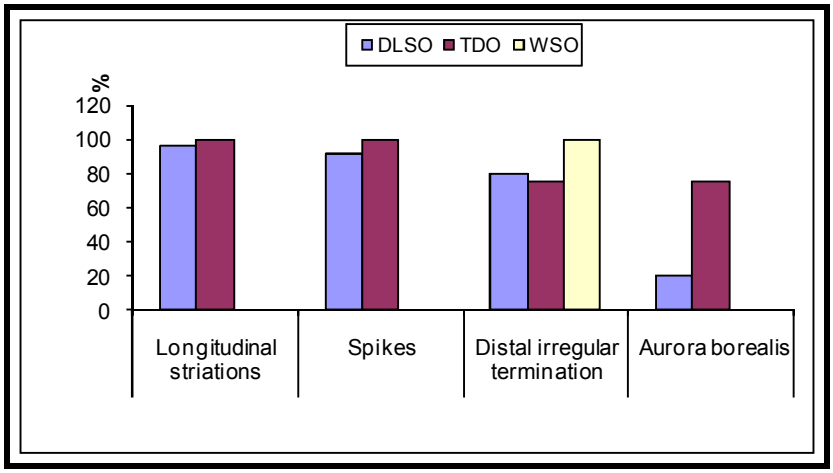


Figure 12: Relation between the different clinical types of onychomycosis and dermoscopic pattern

Culture results

Table 21: culture results

Types of culture	N	%
Yeast	12	40.0%
Mixed	6	20.0%
Mold	4	13.3%
Dermatophyte	2	6.7%
-ve Culture	6	20.0%

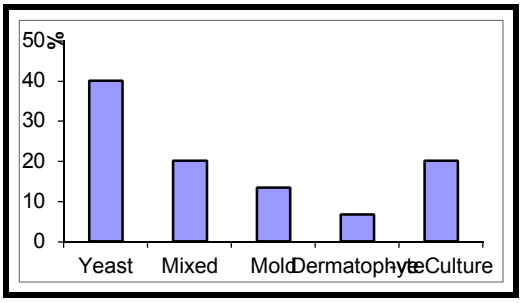


Figure 13: Culture results

Culture with cycloheximide was positive in 15 (50%) and negative in 15 (50%), while culture without cycloheximide was positive in 24 (80%) and negative in 6 (20%).

Positive cultures yielded yeast species in 12 (40.0%), mixed (yeast and mold) in 6 (20.0%), mold species in 4 (13.3%) and dermatophyte species in 2 (6.7%) **(Table 21 and Figure 13).**

Relation between the diagnostic dermoscopic signs and isolated fungal species

There was no significant difference between fungal species regarding the diagnostic dermoscopic signs. In yeast species, longitudinal striations were detected in 39.3%, spikes in 40.7%, distal irregular termination in 37.5% and aurora borealis in 25.0%. In mixed fungal species, longitudinal striations were detected in 21.4%, spikes in 18.5%, distal irregular termination in 25.0% and aurora borealis in 25.0%. In mold species, longitudinal striations were detected in 14.3%, spikes in 14.8%, distal irregular termination in 16.7% and aurora borealis in 12.5%. In dermatophyte species, longitudinal striations were detected in 7.1%, spikes in 7.5%, distal irregular termination in 4.1%and aurora borealis in 12.5%. In –ve culture, longitudinal striations were detected in 17.9%, spikes in 18.5%, distal irregular termination in 16.7%and aurora borealis in 25.0% **(Table 22 and Figure 14).**

Table 22: Relation between the diagnostic dermoscopic signs and isolated fungal species

Culture results	Longitudinal striations		Spikes		Distal irregular termination		Aurora borealis		X2	P
	N	%	N	%	N	%	N	%		
	28	100	27	100	24	100	8	100		
Yeast	11	39.3	11	40.7	9	37.5	2	25.0	1.0	0.9
Mixed	6	21.4	5	18.5	6	25.0	2	25.0	2.03	0.7
Mold	4	14.3	4	14.8	4	16.7	1	12.5	1.1	0.8
Dermatophyte	2	7.1	2	7.5	1	4.1	1	12.5	1.1	0.8
-ve Culture	5	17.9	5	18.5	4	16.7	2	25.0	1.09	0.89

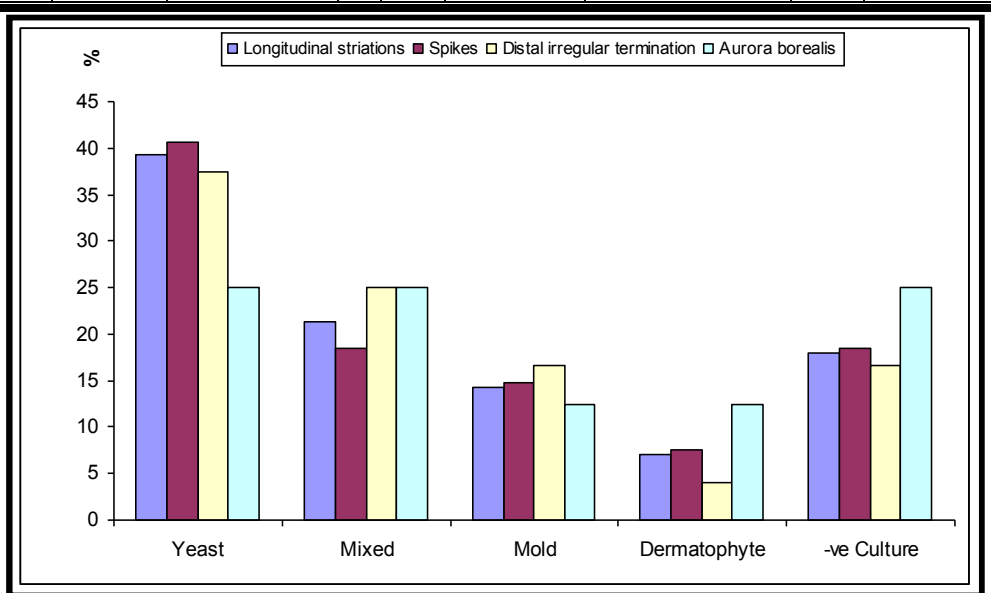


Figure 14: Relation between the diagnostic dermoscopic signs and isolated fungal species

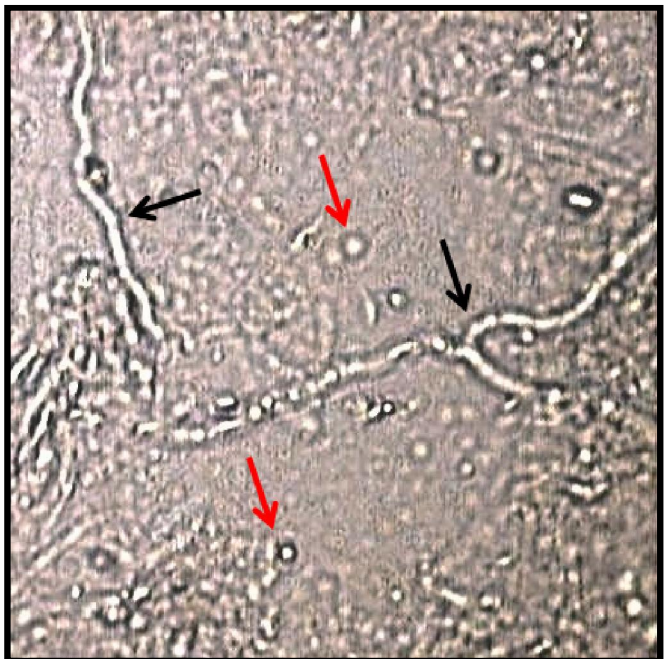
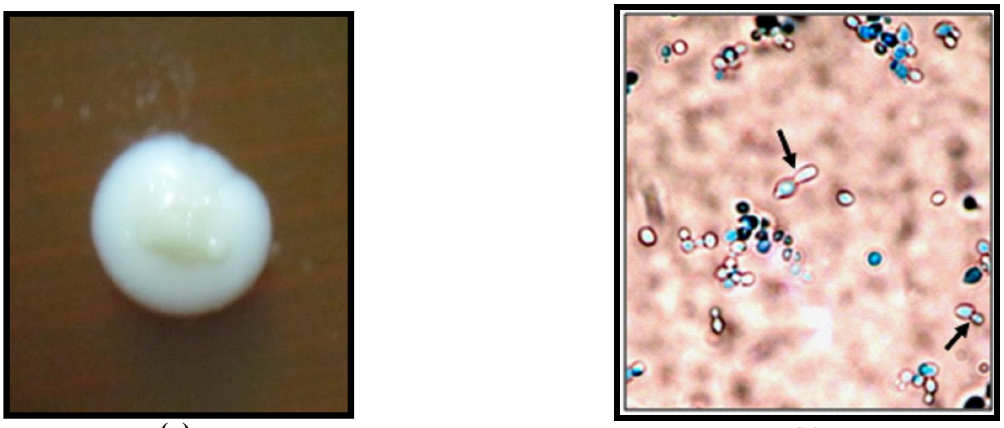
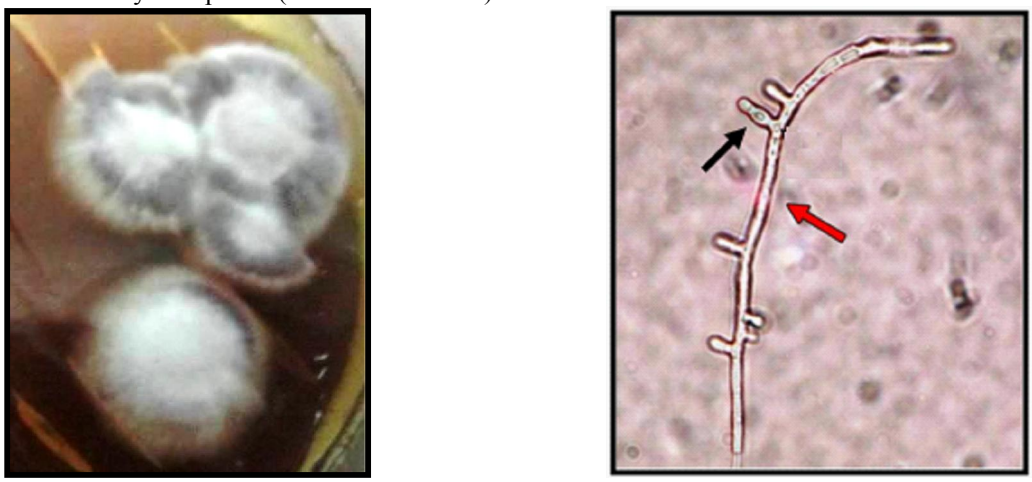


Figure 15: KOH test showing hyaline (non-pigmented), branched, translucent, septate, long, straight hyphae (black arrows) with some arthrospores (red arrows) (KOH mount×200).



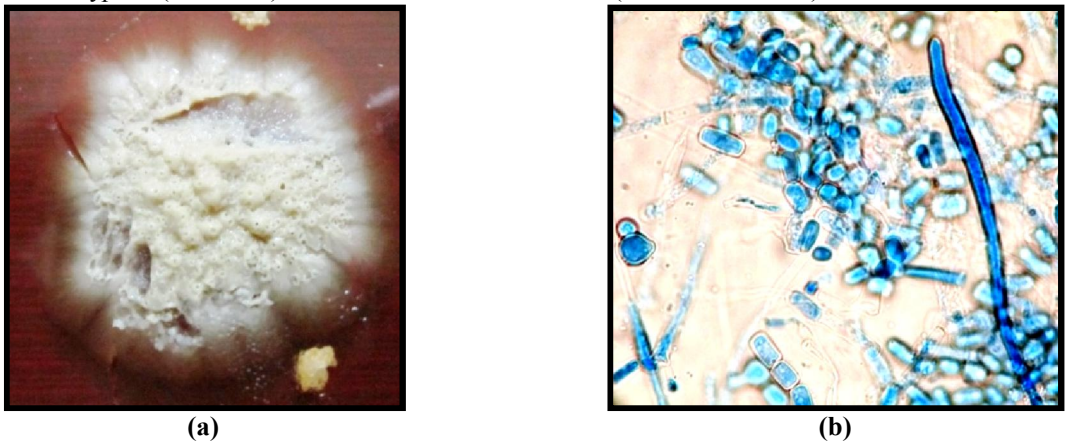
(a) (b)

Figure 16: a) Culture on SDA without cycloheximide showing cream-colored, raised, waxy colonies characteristic of yeast. b) Microscopic morphology of the colonies showing oval, cylindrical to ellipsoidal (black arrows) budding cells characteristic of yeast species (LPCB mount×400).



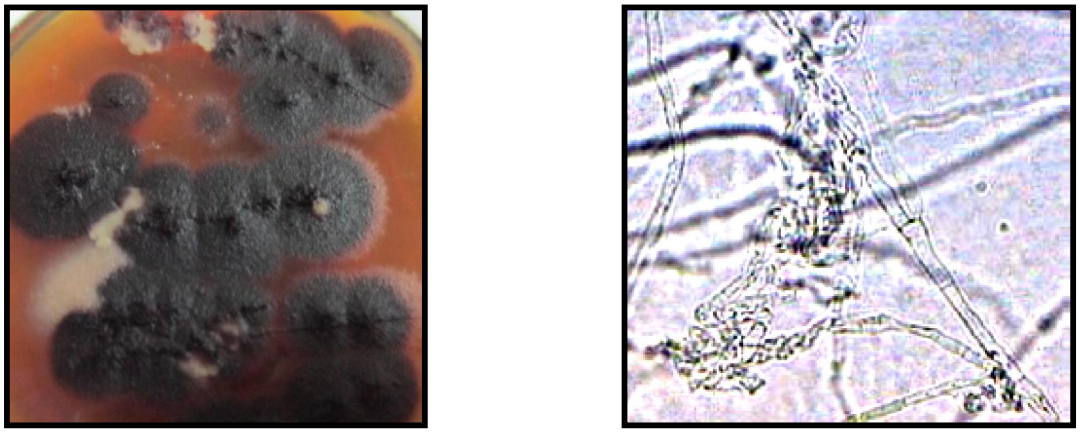
(a) (b)

Figure 17: a) Gross morphology of T. rubrum showing flat to slightly raised, white to cream, suede-like to downy colonies. b) Microscopy of T. rubrum (downy type): Typical slender clavatemicroconidia (black arrow) resting directly on the hyphae (red arrow) with absence of macroconidia (water mount×400).



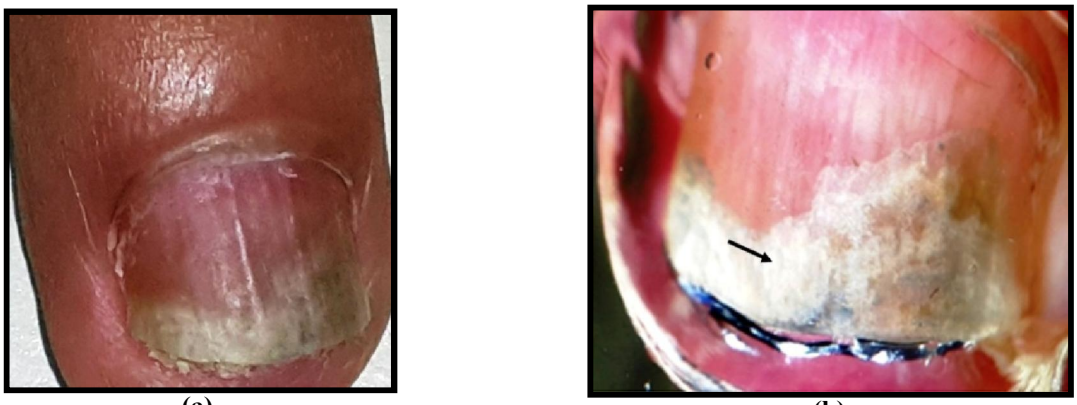
(a) (b)

Figure 18: a) Gross morphology showing white to light cream colored colonies with raised, waxy, cerebriform surface with radial furrows suggestive of *Trichosporon* species. b) Microscopy showing budding cells, cylindrical to ellipsoidal arthroconidia and short regular hyphae/pseudohyphae characteristic of *Trichosporon* species (LPCB mount×400).



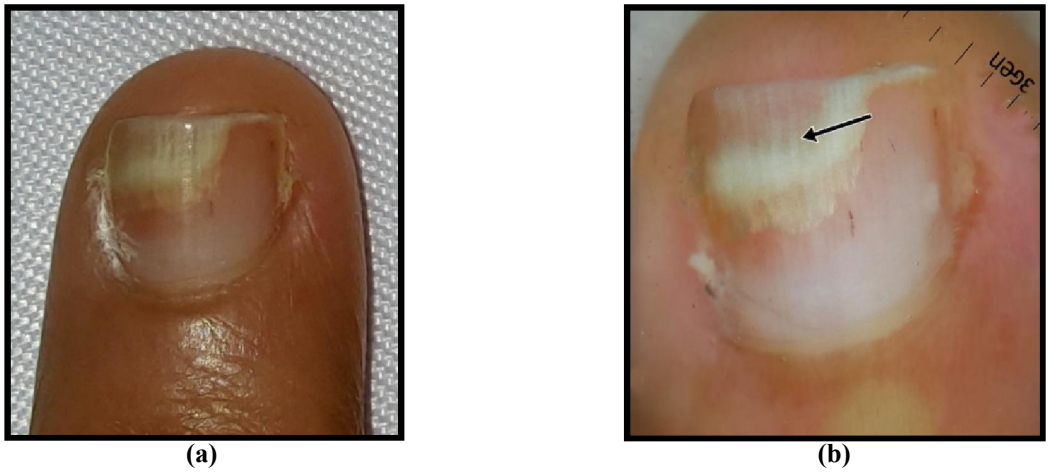
(a) (b)

Figure 19: a) Gross morphology of T. violaceum showing folded deep-violet colonies. b) Microscopy of of T. violaceum showing characteristic tortuous, broad, distorted and much-branched hyphae with lack of conidia (water mount×200).



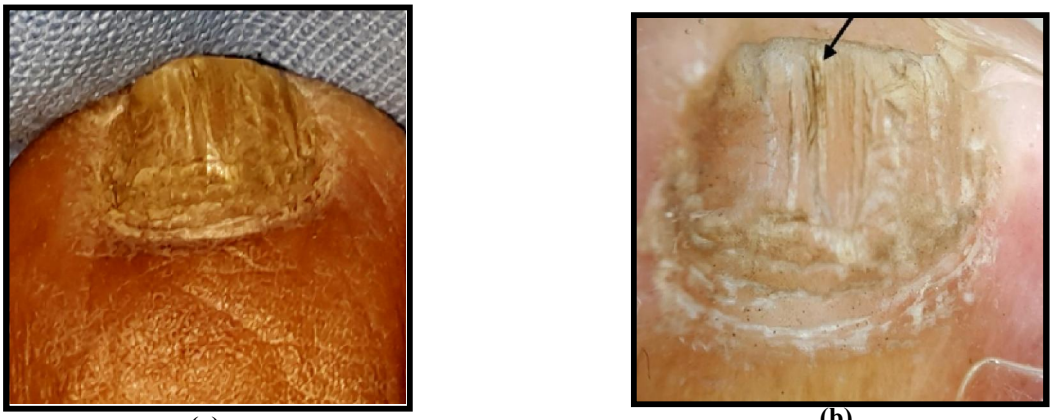
(a) (b)

Figure 20: a) Photographic image showing DLSO b) Dermoscopic image of the same patient showing longitudinal striations (arrow).



(a) (b)

Figure 21: a) Photographic image showing DLSO b) Dermoscopic image of the same patient showing longitudinal striations (arrow).



(a) (b)

Figure 22: a) Photographic image showing TDO b) Dermoscopic image of the same patient showing distal irregular termination (arrow).

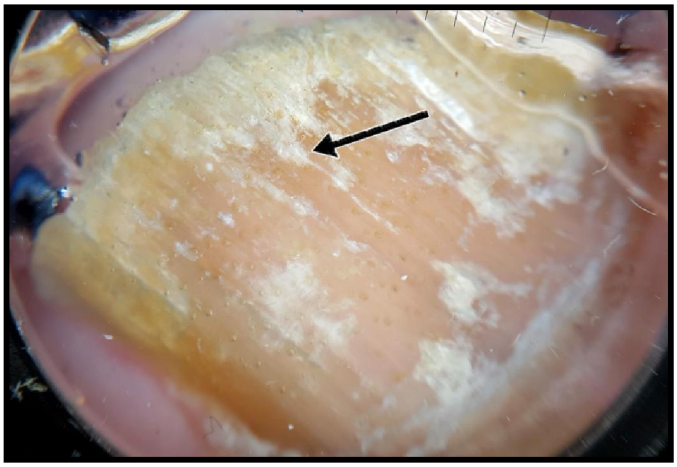


Figure 23: Dermoscopic image showing longitudinal striae (arrow).

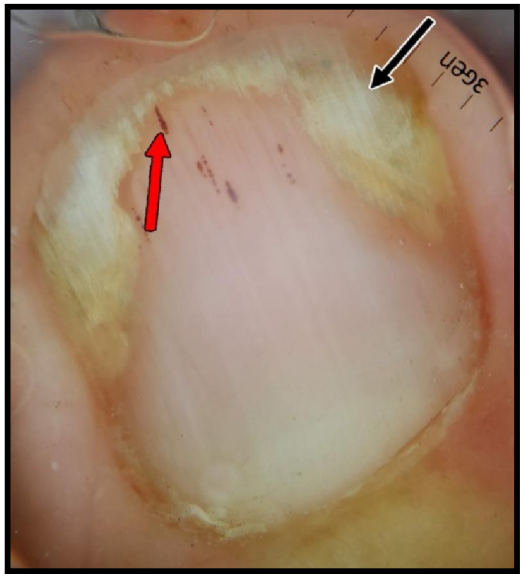
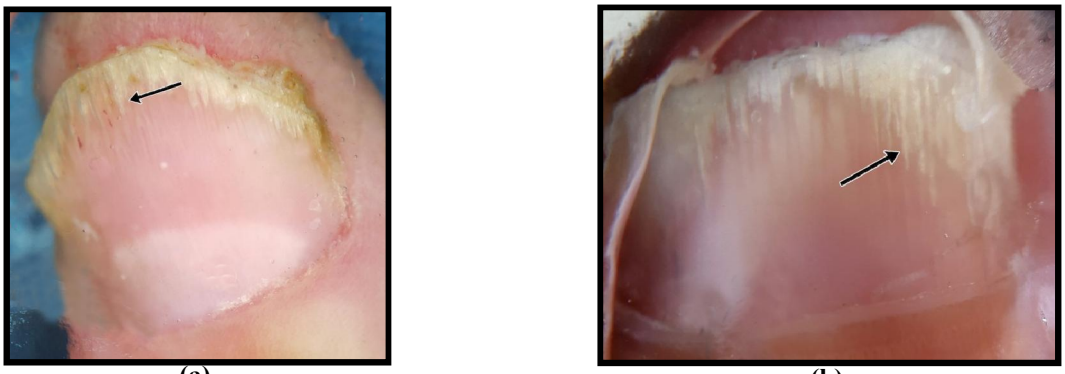


Figure 24: Dermoscopic image showing longitudinal striations (black arrow) and splinter haemorrage (red arrow).



(a) **(b)**

Figure 25: a, b) Dermoscopic images showin spikes (arrows).

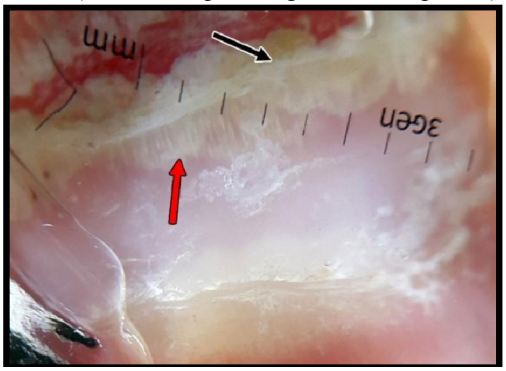
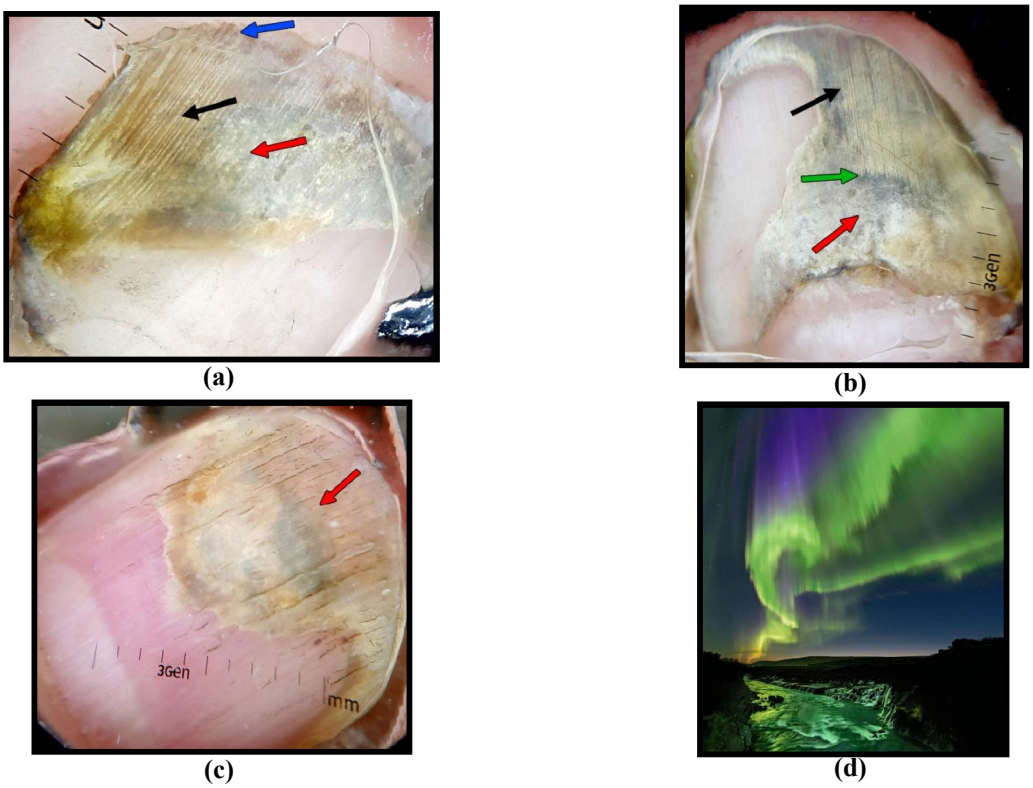


Figure 26: Dermoscopic image showing longitudinal striations (red arrow) and distal irregular termination (black arrow).



(a) **(b)**

(c) **(d)**

Figure 27: a, b, c) Dermoscopic images showinglongitudinal striations (black arrow), aurora borealis (red arrow), distal irregular termination (blue arrow) and spikes (green arrow). d) aurora borealis.

4. Discussion

The use of dermoscopy for the study of nail disorders is recent. In the beginning it was mainly used for the study of nail pigmentations, but later several studies have demonstrated its utility in various nail disorders including onychomycosis ***(Nakamura and Costa, 2012).***

Onychomycosis is one of the most common nail disorders (50 % cases). Accurate diagnosis is important since the treatment can be long-standing and expensive and may be accompanied by severe adverse effects. The diagnosis is made by clinical suspicion along with KOH examination followed by culture of the sample. This method may be uncomfortable and even painful for the patient and may vary significantly when performed by an experienced mycologist with proper sampling technique ***(Jesus-Silva et al., 2017).***

The main utility of dermoscopy in onychomycosis is to differentiate it from traumatic onycholysis or from true melanonychia. There are three dermoscopic findings that are exclusive for onychomycosis: jagged proximal edge with spikes of the onycholytic area, longitudinal striae, and distal irregular termination ***(Jesus-Silva et al., 2015).***

This study included 30 patients with onychomycosis, 80% of them were females and 20% were males. This is similar to results reported by ***Piraccini et al (2013), Jesus-Silva et al (2015)*** *and* ***Kanth et al (2016)***. On the other hand, ***Veer et al (2007)*** reported that men are more affected than females. Also, in a study by ***Raghavendra et al (2015)*** there were 110 males (73.33%) and 40 females (26.66%).

In our study, fingernails were more affected than toenails (56.7% versus 43.3% respectively) which might be due to frequent immersion of hands in water. This finding was consistent with those of ***Rathod et al (2017)***. In contrast, others such as in studies by ***Thomas et al (2010)*** and ***Grover and Khurana (2012)*** reported that onychomycosis affects toenails more often than fingernails. This can be explained by slower growth rate, reduced blood supply, and frequent confinement in dark, moist environments. Toenail onychomycosis may occur in patients with distorted nails, a history of nail trauma, genetic predisposition, hyperhidrosis, concurrent fungal infections, and psoriasis. It is also more common in smokers and in those who use occlusive footwear and shared bathing facilities.

The present study showed significant difference between males and females regarding site of nail affection (P=0.018*), defining that toenail affection was more common in females. This is consistent with ***Gerame Shoar et al (2002)*** who found high rate of female toenail infection rather than fingernail involvement. Also, ***Abdullah and Abbas (2011)*** reported that nail changes are often not brought to the men who generally have thicker nail plates than women have. In contrast, studies by ***Rogers et al (1996), Gupta et al (2000), Zaini et al (2009) and James et al (2016)*** reported that onychomycosis of toenails was more common in male patients.

Three clinical patterns had been detected in the present study. DLSO was the major clinical pattern present in 83.4% of patients, followed by the TDO (13.3%), and WSO (3.3%). Same findings were detected in the study of ***De Crignis et al (2014***) who performed a dermoscopic study in a series of 502 cases in Brazil. DLSO was present in 336 cases (66.93%). ***Yadav and Khopkar (2016)*** reported DLSO in 62% while ***Rathod et al (2017)*** reported DLSO in 23 (9.2%) followed by TDO 16 (6.4%) then PSO in one case (0.4%). In the study by ***Piraccini et al (2013)*** DSO pattern was present in 33 cases which was the only clinical pattern in that study.

On the other hand, ***Raghavendra et al (2015)*** reported that TDO was seen in 46%, DLSO in 34.6%, MO (mixed onychomycosis) in 10.66%, SWO in 7.33% and PSO in 2 cases. Also, in the study of ***Jesus-Silva et al (2015),***87 patients (56.13%) were clinically classified as having TDO, 67 (43.23%) as having DLSO, 1 (0.65%) with trachyonychia and none had WSO.

The diagnostic dermoscopic signs in this study were longitudinal striations (93.3%), spikes (90.0%), distal irregular termination (80.0%) and aurora borealis (26.7%). Our findings were consistent with those of ***Piraccini et al (2013)***, who reported that jagged proximal edge with spikes of the onycholytic area and longitudinal striae are peculiar dermoscopic features of onychomycosis.

Longitudinal striations and spikes were the commonest diagnostic dermoscopic signs seen in DLSO (24/25; 96.0%) and TDO (4/4; 100.0%). Similarily, ***Jesus-Silva et al (2015***) reported the "longitudinal striae pattern" was more frequently observed in patients with TDO or DLSO. Something similar happened with the spiked pattern, which was also frequently identified in patients with clinical diagnosis of TDO and DLSO**.**

Also, ***Rathod et al (2017),*** they showed that the dermoscopic signs of DLSO were longitudinal striae 73.9% and spikes 60.9%.

De Crignis et al (2014) reported that DLSO cases showed ruin appearance in 88.09% and longitudinal striae in 79.46%. A study by ***Yadav and Khopkar (2016)*** reported that all patients with DLSO showed white, irregular streaks demarcating the area of onychomycosis with the normal nail. The streaks were sharp and distinct and were present throughout the entire length of the involved area. These streaks are projected toward the normal part of the nail.

Chromonychia (aurora boreails) was seen in 13 patients and it was statistically significant.

We also identified other dermoscopic features observed with high frequency in onychomycosis, but not exclusive to it.

Nail color was abnormal in all cases. Our findings were consistent with those of ***Rathod et al (2017)*** in whichall cases had yellowish white discoloration 100%. In study by ***Piraccini et al (2013)*** showed that the white discolouration presented a P-value close to the statistical significance (P = 0.006).

In our study distal edge of nail plate was irregular in 24 (80.0%) cases (20 cases with DLSO and 3 cases with TDO). linear edge was detected in 6 (20.0%) cases (5 cases with DLSO and one case with TDO). ***Jesus-Silva et al (2015***) reported that linear edged pattern was evident in 34 patients, 21 clinically compatible with TDO (58.8%) and 13 with DLSO (38.2%). Distal irregular termination was present in 67 patients, 41 (61.76%) clinically compatible with TDO and 26 patients (38.8%) with DLSO. ***Piraccini et al (2013)*** reported that linear edge was present in 13 ⁄ 13 cases of traumatic onycholysis, and in 0 ⁄ 37 cases of DSO (sensitivity of linear edge in traumatic onycholysis: 100%).

In the current study splinter hemorrhage (assign of capillary bleeding) was present in 5 cases (16.7%). This coincides with ***Elfar et al (2015)*** who reported that splinter hemorrhage was found in 2/17 patients (11.76%). On the other hand, ***Rathod et al (2017)*** reported that splinter haemorrage was detected in 93.8% of TDO cases. Moreover, ***Farias et al (2010)*** found that splinter hemorrhage was common, although nonspecific. It was found in cases of onychomycosis, trauma, and psoriasis.

Subungual hyperkeratosis was present in 25 cases (83.3%). This finding was in accordance with ***Yadav and Khopkar (2016)*** who reported that subungual hyperkeratosis was seen in 7 patients which was statistically significant ($P < 0.05$). Also, ***Rathod et al (2017)*** reported that subungual hyperkeratosis was detected in 73.9% of DLSO cases.

Nail plate thickening was present in 27 cases (90.0%) while, nail plate onycholysis was present in 8 cases (26.7%). A study by ***Rathod et al (2017)*** reported that rough scaly surface was present in 100% of cases and onycholysis was detected in 50% of TDO cases.

Opposed to most literature, we could not detect dot pattern in our study. Most authors, including, ***Farias et al (2010), Piraccini et al., 2013, Elfar et al (2015) and Rathod et al (2017)*** reported that despite of its presence, dot pattern was not statistically significant and not exclusive to onychomycosis.

There is general agreement that dermatophytes are the most prevalent fungal species causing onychomycosis, as mentioned in studies by ***Gupta et al (2000), Tan et al (2005) Gupta and Ricci (2006) Szepietowski et al (2006) Kaur et al (2008)*** and ***Elfar et al (2015).*** The last authors reported that T. rubrum was the most isolated fungus (14 cases; 58.33%) and T. mentagrophyte was the least isolated (one case; 4.17%). Candida was isolated in seven cases (29.17%).

Our study showed that yeast (12, 40.0%) was the commonest fungal species causing onychomycosis followed by mold (4, 13.3%) and dermatophytes (2, 6.7%). Mixed etiology (yeast and mold) was detected in (6, 20.0%), Going with these results, ***Shoar et al (2002)***, ***Mikaeili and Karimi (2013) and Gelotar et al (2013)*** reported that the predominant pathogen was yeast (64.71%), followed by dermatophytes (17.65%). A mixed infection was identified in 11.76%. Overall, the causative agents vary depending upon geographical location and temporal distribution**.**

Our study showed that there was no significant difference between fungal species regarding the diagnostic dermoscopic signs. This coincides with ***Singal and Khanna (2011)*** and ***Shenoy and Shenoy (2014)*** whoreported thatthere are nospecific clinical patterns for onychomycosis caused by aspecific spp and all patterns can be seen with all fungalspecies; hence, no specific dermoscopic feature can be recognized for each causative organism. This means that fungal culture remains the gold standard for fungal identification.

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