Original paper

Dermoscopy as a first step in the diagnosis of onychomycosis

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Abstract

Introduction: Over the years, clinical studies have provided new knowledge about the dermoscopic features of the diseases of cutaneous annexes. It seems that dermoscopy has opened a new morphological dimension in the diagnosis and management of hair disorders and onychopathies.

Aim: To identify and describe dermoscopic features of onychomycosis.

Material and methods: A total of 81 consecutive patients with onychomycosis (55 men and 26 women) were prospectively enrolled in the present study. For each patient, all fingernails and toenails were evaluated in clinical and dermoscopic examinations. Mycological tests were performed by potassium hydroxide (KOH) preparation. Mann-Whitney *U* and χ^2 tests were used for the statistical analysis, with a significance threshold of $p < 0.05$.

Results: Dermoscopic examination of the patients' nails revealed the following: jagged proximal edge with spikes of the onycholytic area (51.9%), longitudinal streaks and patches (44.4%), subungual hyperkeratosis (27.2%), brown-black pigmentation (9.9%) and leukonychia (1.2%). Jagged proximal edge, subungual hyperkeratosis and leukonychia were positively associated with the onychomycosis type.

Conclusions: Onychomycosis accounts for up to 50% of all consultations for onychopathies. Fast and effective diagnostic approaches are needed in everyday clinical practice. Dermoscopy can provide immediate and accurate information in the diagnosis of onychomycosis. We suggest that dermoscopy should be taken as a first step toward the diagnosis of onychomycosis.

Key words: onychomycosis, dermoscopy, jagged proximal edge, fungal melanonychia, ruin appearance.

Introduction

Dermoscopy is a non-invasive, practical imaging method that allows *in vivo* evaluation of pigmented and nonpigmented skin lesions [1, 2]. The importance of dermoscopy in the diagnosis of nail disorders has become increasingly well understood [3]. Onychomycosis is the most common nail infective disorder, which has been reported to account for up to 50% of all consultations for nail diseases [4]. According to epidemiological studies, the prevalence of onychomycosis is expected to rise in the coming years [5, 6]. Dermoscopy appears to be a rapid and useful tool in the diagnosis of onychomycosis. It allows prompt and nonprocedural assessment of the entire nail unit compared to mycological examinations [4, 7–20].

Aim

In this prospective study, we attempted to describe and explore dermoscopic features of onychomycosis.

Material and methods

A total of 81 consecutive patients (55 men and 26 women; mean age, 54.64 ±14.9 years (range: 18–85 years)) with onychomycosis were prospectively enrolled in the present study between March and September 2016. The study was conducted according to the principles of the Declaration of Helsinki and was approved by the local medical ethical committee. All the patients were given a description of the study and provided written informed consent. The study inclusion criterion was the evidence of any clinical signs of onychomycosis. A history including duration of onychomycosis was obtained from each subject. For each patient, all fingernails and toenails were evaluated in clinical and dermoscopic examinations and a potassium hydroxide (KOH) examination of scrapings from clinically and dermoscopically onychomycotic nail plates was performed. Nail plate dermoscopy was performed by a video-dermoscopy (MoleMax I Plus). Ultrasound gel was used as an immersion medium. Pa-

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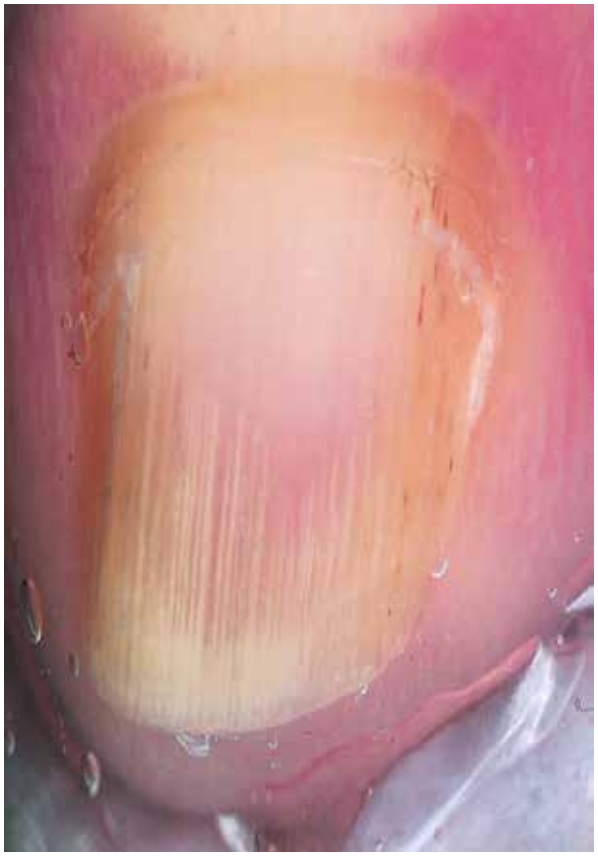

Figure 1. Longitudinal streaks in distal subungual onychomycosis (20×)

Figure 3. Whitish-yellow patches with jagged proximal edge (20×)

tients were classified according to morphological types of onychomycosis: distal subungual onychomycosis (DSO), total dystrophic onychomycosis (TDO), proximal subungual onychomycosis (PSO), white superficial onychomycosis and endonyx onychomycosis.

Figure 2. Distal subungual onychomycosis: dermoscopy shows spikes at the proximal margin of the onycholytic area (40×)

Statistical analysis

The statistical analysis was performed using SPSS software (version 18; SPSS Inc., Chicago IL, USA). Categorical variables related to the epidemiological and clinical characteristics of patients are reported as numbers and percentages. Continuous variables such as age, onychomycosis duration and affected toe and fingernail numbers are reported as means ± standard deviations and ranges. The Mann-Whitney *U* test was used to determine if there were statistical associations between onychomycosis type and the presence or absence of specific dermoscopic features. A p-value of < 0.05 was considered to be statistically significant.

Results

The duration of onychomycosis ranged from 2 to 360 months (mean ± SD: 88.9 ±101.1). All patients had at least 1 affected toenail. The number of affected toenails ranged from 1 to 10 (3.98 ±3.2). Fingernails were affected in 9 of 81 patients (11.1%), and the number of affected fingernails ranged from 1 to 7 (0.3 ±1.1). KOH positivity was observed in 72 of 81 patients (88.9%). 74.1% of the patients (n = 60) had DSO, 24.7% (n = 20) had TDO and 1.2% (n = 1) had PSO. We have not observed any patient with white superficial onychomycosis or endonyx onychomycosis. Dermoscopic examination of the patients' nails revealed the following: jagged proximal edge with spikes of the onycholytic area in 51.9% (n = 42), longitudinal streaks and patches in 44.4% (n = 36), subungual hyperkeratosis in 27.2% (n = 22), leukonychia in 1.2% (n = 1), brown-black pigmentation in 9.9% (n = 8) of the patients (Figures 1–18). 25.9% of the patients (n = 21) had

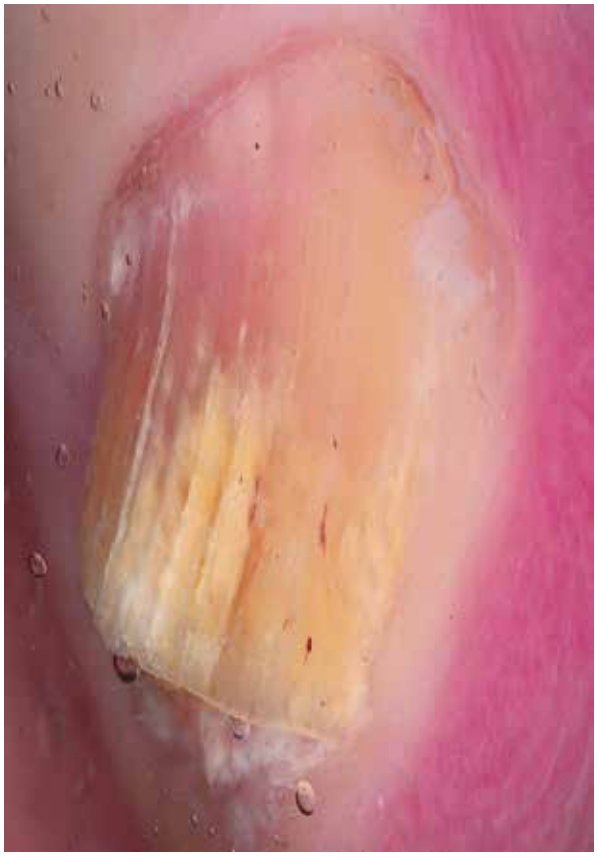

Figure 4. Whitish-yellow patches in distal subungual onychomycosis (20×)

two, 2.5% (n = 2) had three and 1.2% (n = 1) had four dermoscopic findings. Statistically significant relationships were observed between the type of onychomycosis and the presence of jagged proximal edge (p = 0.013), the presence of subungual hyperkeratosis (p < 0.001) as well as the presence of leukonychia (p = 0.025). Jagged proximal edge with spikes was significantly more likely to be seen in patients with DSO and subungual hyperkeratosis was significantly more likely to be seen in patients with TDO. In addition, patients with PSO were significantly more likely to exhibit leukonychia (Table 1).

Discussion

According to the results of our study, jagged proximal edge with spikes of the onycholytic area was the most common dermoscopic finding. When compared with traumatic onycholysis, in onychomycosis the onycholytic area has a jagged proximal border instead of a linear one. Directed to the proximal nail fold, sharp longitudinal indentations are called spikes, which are the reason for the jagged appearance [7–9, 11, 14, 20]. These structures correspond to onset of fungal invasion and are not detected in traumatic onycholysis [20]. An explanation of these findings lies in understanding the nature of the nail unit.

Figure 5. A patch extending proximally, which shows involvement of the matrix (20×)

It is known that the nail plate lies distally on a firmly adherent nail bed. Nail plate has parallel longitudinal rete ridges that conform to complemental epidermal ridges on the nail bed. This unique longitudinal arrangement has led to the description of the nail being led up the nail bed as if on rails. Indeed, the nail bed is defined as the territory upon which the nail rests extending from the lunula to the hyponychium. The hyponychium, where the nail plate separates from the underlying tissue, represents a space as much as a surface. It is one of the weakest areas of the nail apparatus, which may serve as a reservoir for pathogens [21, 22].

In our opinion, most of the dermoscopic signs of onychomycosis share one common pattern, that is the longitudinal configuration. It is obvious that spikes, streaks, patches all have longitudinal arrangement. This is because fungal elements invade the nail bed from the hyponychium, which is a low adherence region, and colonization progresses through the longitudinal rete ridges.

Figure 6. Fungal melanonychia: yellowish-white streaks within the black pigmentation, note the black reverse triangle (red triangle) and superficial transverse striations (20×)

Figure 7. Pigmented distal subungual onychomycosis: multi-coloured pigmentation and jagged proximal border, note the scales on the surface (20×)

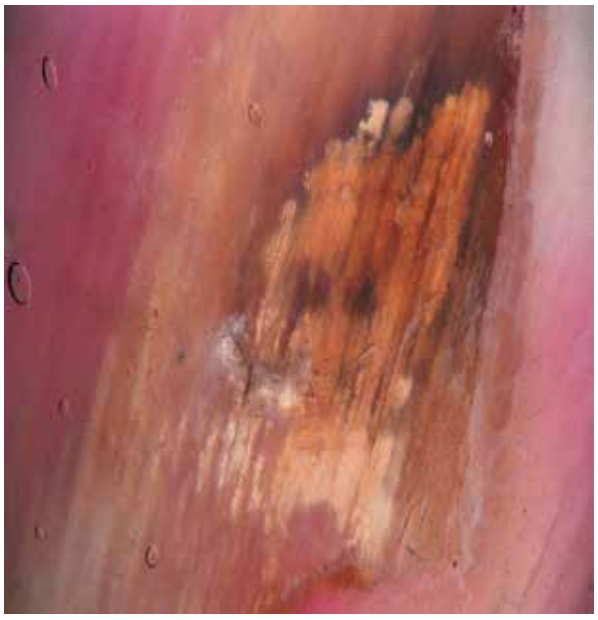

Figure 8. Multi-coloured pigmentation (30×)

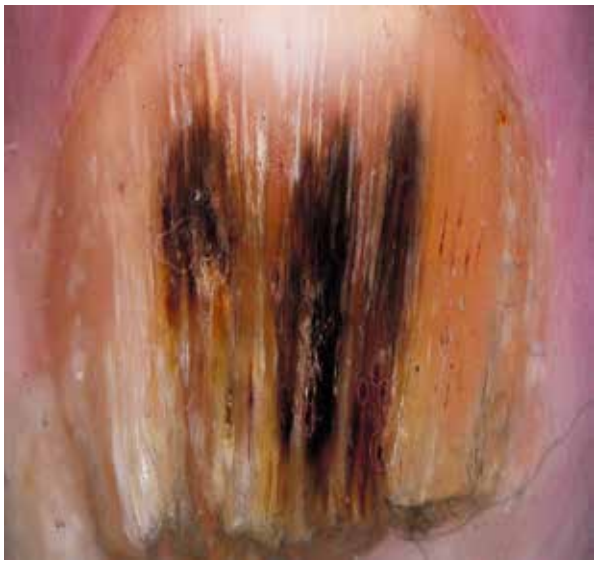

Figure 9. Fungal melanonychia: dermoscopy shows black pigment aggregates (red circles) within multi-coloured pigmentation (30×)

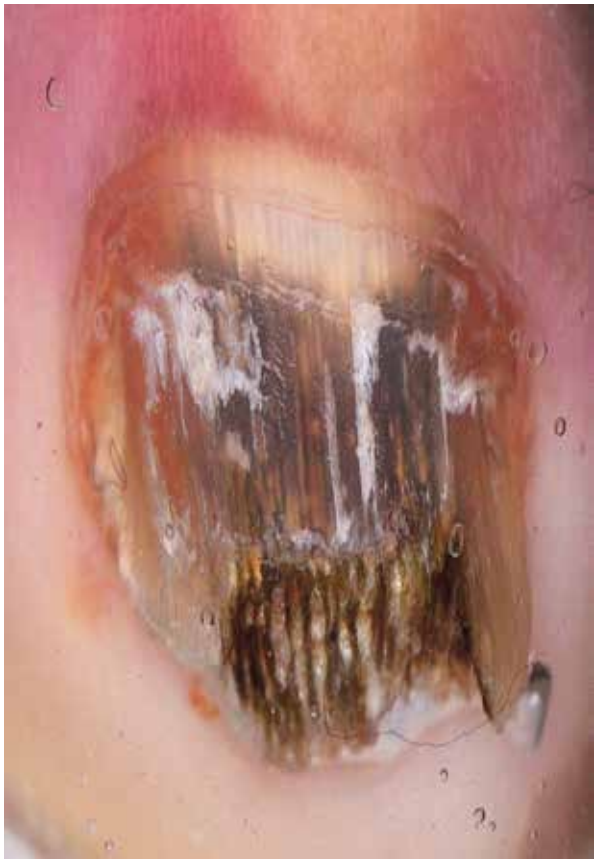

Figure 10. Total dystrophic onychomycosis: multi-coloured pigmentation and subungual hyperkeratosis. Note the scales on the surface, reflecting a microdystrophic change caused by nail fragility resulting from the presence of the microorganism (20×)

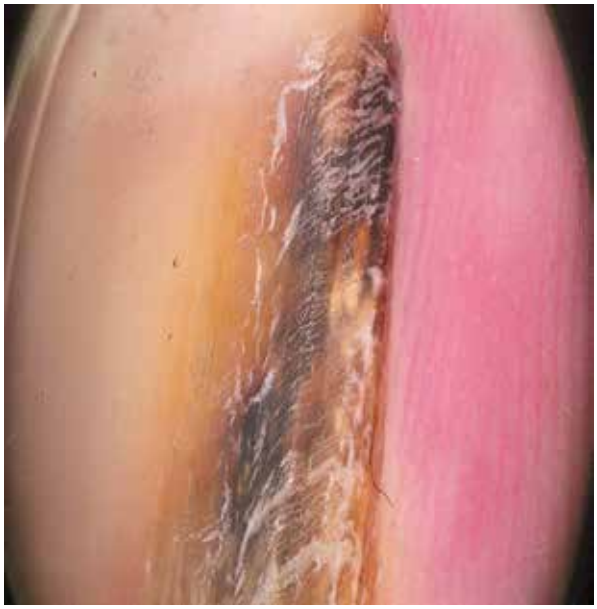

Figure 12. Superficial transverse striations, reverse triangular pattern (20×)

Figure 11. Irregular matt pigmentation and longitudinal striae (20×)

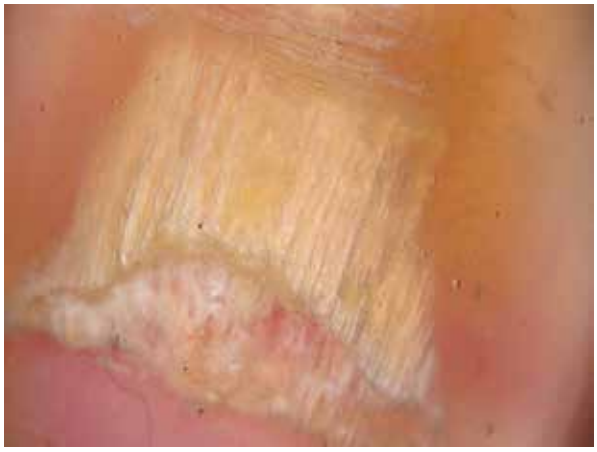

Figure 13. Subungual hyperkeratosis and longitudinal striae (30×)

Spikes, streaks and patches are dermoscopic signs seen in DSO. On the other hand, it is known that long-standing DSO may result in TDO [4], of which dermoscopic features are subungual hyperkeratosis and longitudinal streaks and patches extending towards the proximal nail plate (Figure 10). A special dermoscopic term has been described for subungual hyperkeratosis seen in onychomycosis. "Ruin appearance" keratosis defines the indentations on the ventral portion of the nail plate, which occurs due to the accumulation of dermal debris reacting to the process of fungal invasion [14, 20]. Ruin appearance confirms downward colonization of fungal elements at the subungual level. As it is seen in Figure 10, in contrast to crumbled areas, on the proximal nail plate, the colour

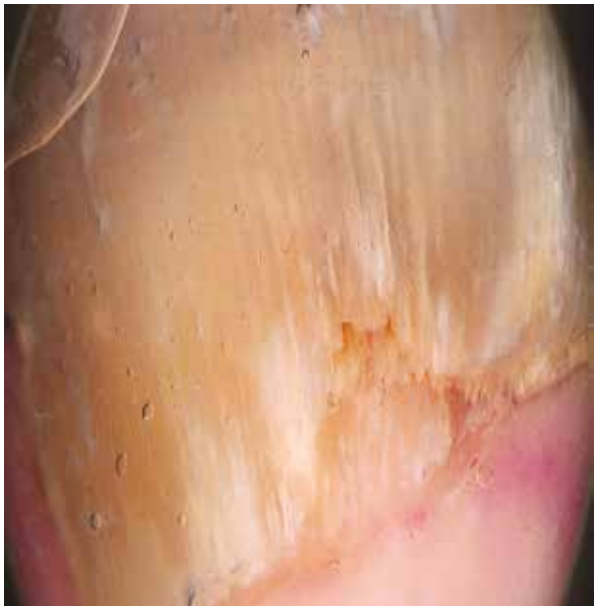

Figure 14. Longitudinal striae and ruin appearance in the hyperkeratotic area (20×)

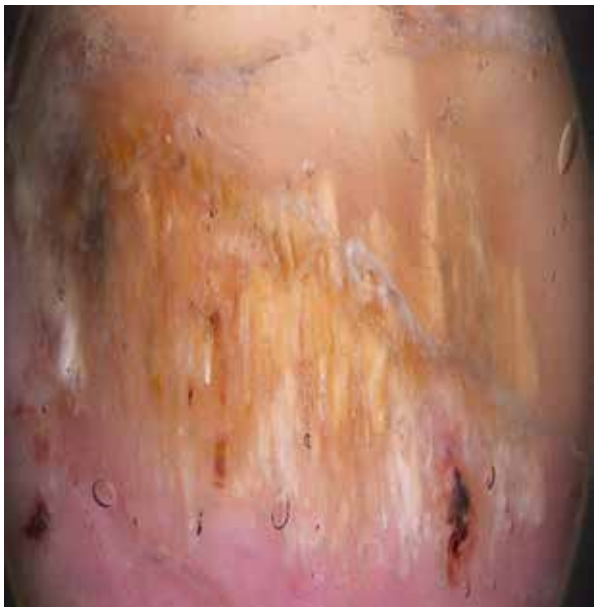

Figure 16. Subungual hyperkeratosis and jagged proximal edge with longitudinal striae (20×)

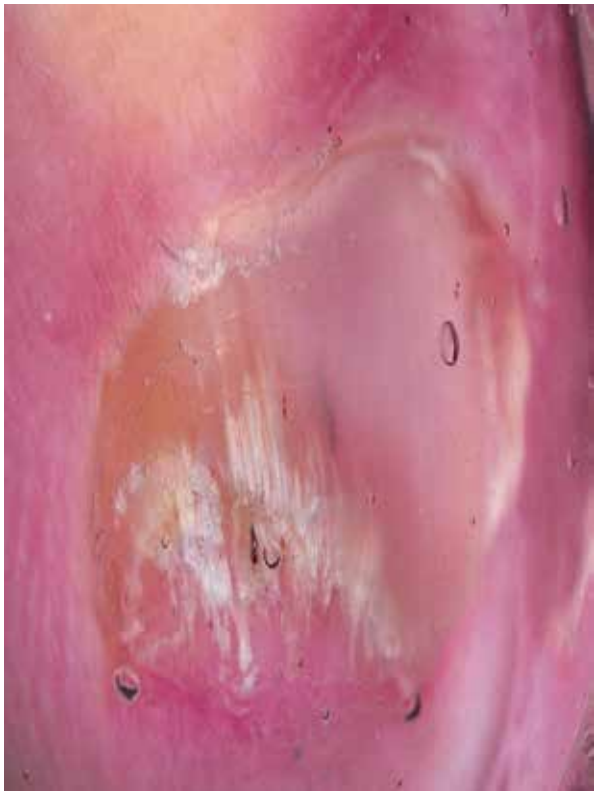

Figure 15. Jagged edge with longitudinal streaks, subungual hyperkeratosis (20×)

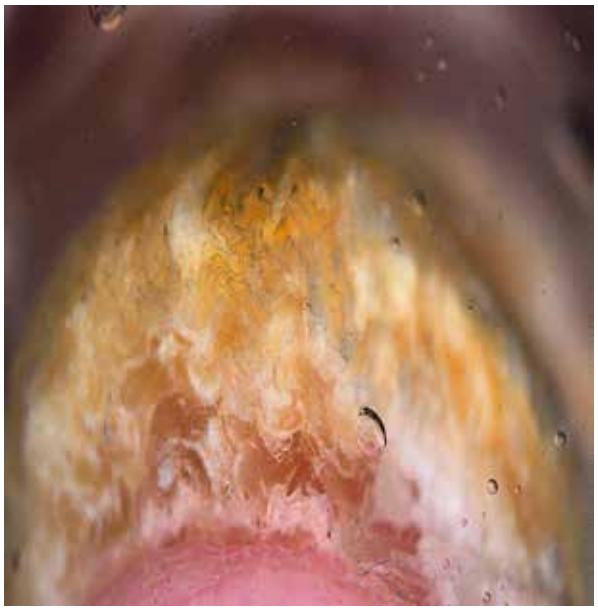

Figure 17. Distal free edge dermoscopy shows ruin appearance (40×)

of streaks has a matt hue, which also indicates subungual localization of the streaks.

In our study, another dermoscopic feature of onychomycosis was pigmentation. It is known that fungal infections may cause nail pigmentation and fungal melanonychia (FM) should be considered in the differential diagnosis of nail unit melanoma [16–19, 23]. However, there are no adequate data in the literature to define detailed FM characterization [18, 19]. Homogeneous pigmentation and absence of visible melanin inclusions were recognized as dermoscopic signs of onychomycosis [24]. Not long ago, Kilinc Karaarslan *et al*. identified

new dermoscopic features of FM. They have revealed that multi-coloured, matt black, matt white, or yellow to brown pigmentation, black pigment aggregates, black reverse triangle, superficial transverse striation and blurred appearance of pigmentation were the exclusive dermoscopic features of FM [19]. More recently, Ohn *et al.* reported that FM is associated with the presence or absence of certain dermoscopic patterns. According to the results of their study, white or yellow streaks, non-longitudinal homogenous pattern, yellow colour, reverse triangular pattern, subungual hyperkeratosis, multi-colour pattern and scales on the nail are positive predictors of FM [18]. In this study, we have also observed multi-coloured and irregular matt pigmentation, black pigment aggregates, black reverse triangle and superficial transverse striations, which have been described as typical dermoscopic features of FM.

In this study, we have observed a patient with PSO, of whom dermoscopic examination of nails revealed patches of true leukonychia. Proximal subungual onychomycosis has been regarded as a specific form of onychomycosis, in which pathogenic fungus invades the nail plate from the eponychium. In PSO, fungal invasion emerges from the stratum corneum on the ventral aspect of the proximal nail fold and progresses distally. When the nail matrix is involved, fungal elements mainly spread to the lower parts of the nail plate. A typical clinical manifestation of PSO is a white patch visible through the transparent nail plate. Since the deeper portions of the nail plate are affected, the nail plate surface is normal and true leukonychia is the main clinical sign [4, 25]. We want to emphasize a distinguishing dermoscopic feature of PSO, which is the linear edged leukonychia. In contrast to DSO, where fungal elements invade the nail bed from the hyponychium [20], in PSO infection starts from the eponychium [25]. As mentioned above, in DSO fungal colonization progresses through the longitudinal rete ridges of the nail bed and plate, which is the reason for the spiky appearance, while in PSO, invasion spreads to the lower parts of the nail plate and advances distally [25] leading to a distinguishing linear edge on dermoscopy.

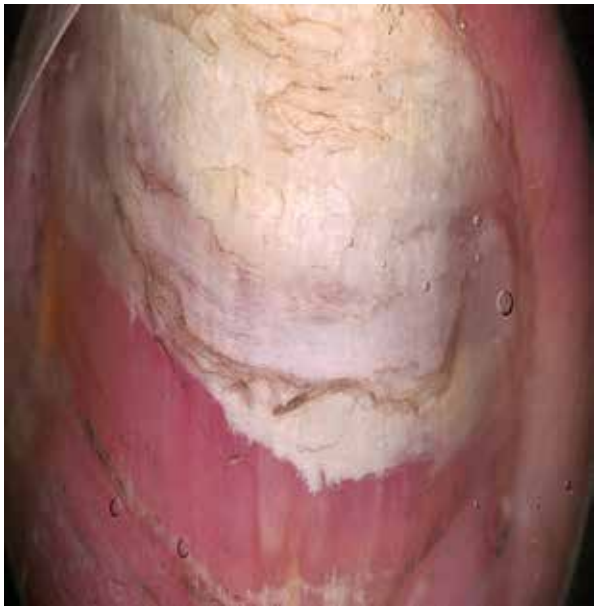

Figure 18. Proximal subungual onychomycosis: dermoscopy shows a linear edged white patch expanding distally (20×)

Conclusions

Onychomycosis is the most common nail infective disorder [4]. Current findings indicate that onychomycosis will still represent an important percentage of diseases encountered by the dermatologist [5]. Easily accessible, standardized and well established diagnostic procedures are needed in everyday practice. Mycological culture and direct microscopic examinations have been regarded to be traditional confirmatory tests in the diagnosis of onychomycosis. On the other hand, it is known that both have low sensitivity but high false-negative re-

Table 1. Statistical analysis of the dermoscopic features in regard to onychomycosis type

Variable		Median (min.–max.)*	*P*-value
Jagged proximal edge with spikes of the onycholytic area	A (n = 39) P (n = 42)	1 (1–3) 1 (1–2)	0.013
Longitudinal streaks and patches	A (n = 45) P (n = 36)	1 (1–3) 1 (1–2)	0.783
Subungual hyperkeratosis	A (n = 59) P (n = 22)	1 (1–3) 2 (1–2)	< 0.001
Leukonychia	A (n = 80) P (n = 1)	1 (1–2) 3 (3–3)	0.025
Brown-black pigmentation	A (n = 73) P (n = 8)	1 (1–3) 1 (1–2)	0.360

*Median (minimum-maximum values), A – absent, P – present. *1 – distal subungual onychomycosis, 2 – total dystrophic onychomycosis, 3 – proximal subungual onychomycosis.*

sults. New diagnostic methods for onychomycosis are on the horizon, which require trained personnel and sophisticated techniques [26, 27]. Nail dermoscopy is becoming more commonly utilized in the assessment of nail diseases [3]. Our study is among the limited number of studies investigating dermoscopic findings of onychomycosis. This study extends the current literature by demonstrating significant dermoscopic findings. A limitation of our study, however, is the lack of cultural confirmation. In our study, KOH positivity was 88.9% and mycological culture was not performed for confirmation because of the drawback of the long turnaround time. Over the years, collective global experience on dermoscopy has grown. Dermoscopy has added new dimensions to the diagnosis of a countless number of diseases. We suggest that this quick, non-invasive and highly effective tool should be considered as the first step in the diagnosis of onychomycosis.

Conflict of interest

The authors declare no conflict of interest.

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