DOI: https://doi.org/10.54393/pjhs.v7i8.3925

PAKISTAN JOURNAL OF HEALTH SCIENCES
(LAHORE)
https://thejas.com.pk/index.php/pjhs
ISSN (E): 2790-9352, (P): 2790-9344
Volume 7, Issue 08 (August 2026)

OPEN ACCESS

Check for updates

Original Article

Determination of Association between Onychoscopy Features and Nail Plate Potassium Hydroxide Test Positivity in Diagnosis of Onychomycosis: A Cross-Sectional Study

Khubaib Tahir[1*], Sumera Hanif[2], Rabia Shaukat[3], Aliza Hamadani[1], Ayesha Arshad Chattha[1], Iram Kausar[1] and Haroon Nabi[1]

[1]Department of Dermatology, Lahore Medical and Dental College, Ghurki Trust Teaching Hospital, Lahore, Pakistan
[2]Department of Dermatology, Services Institute of Medical Sciences, Lahore, Pakistan
[3]Department of Dermatology, Allama Iqbal Medical College, Lahore, Pakistan

ARTICLE INFO

Keywords:
Onychoscopy, Onychomycosis, Onychoscopic Features, Onycholysis, Jagged Edge, Potassium Hydroxide Microscopy

How to Cite:
Tahir, K., Hanif, S., Shaukat, R., Hamadani, A., Chattha, A. A., Kausar, I., & Nabi, H. (2026). Determination of Association between Onychoscopy Features and Nail Plate Potassium Hydroxide Test Positivity in Diagnosis of Onychomycosis: A Cross-Sectional Study: Onychoscopy Features and Nail Plate Potassium Hydroxide Test Positivity in Onychomycosis. Pakistan Journal of Health Sciences, 7(8), 09-14. https://doi.org/10.54393/pjhs.v7i8.3925

***Corresponding Author:**
Khubaib Tahir
Department of Dermatology, Lahore Medical and Dental College, Ghurki Trust Teaching Hospital, Lahore, Pakistan
khubaibtahir123@gmail.com

Received Date: 3rd February, 2026
1st Revision Received: 13th March, 2026
Acceptance Date: 8th April, 2026
Published Date: 31st August, 2026

ABSTRACT

Onychomycosis is a common chronic fungal infection of the nails, causing significant physical and psychological morbidity. In Pakistan, access to fungal culture and molecular diagnostics is limited, creating a need for non-invasive, rapid, and cost-effective diagnostic tools. **Objectives:** To determine the association between onychoscopic features and KOH positivity in clinically suspected onychomycosis. **Methods:** This cross-sectional observational study was conducted in the Department of Dermatology, Ghurki Trust and Teaching Hospital, Lahore, Pakistan, from 7 August 2025 to 10 January 2026. A total of 52 patients with clinically suspected onychomycosis were enrolled. Each patient underwent onychoscopic examination followed by nail plate potassium hydroxide (KOH) testing for fungal confirmation. Onychoscopic features, including onycholysis, jagged edge with spikes, longitudinal striae, subungual hyperkeratosis, and chromonychia, were documented. Sensitivity, specificity, predictive values, and diagnostic accuracy were calculated for each feature using KOH microscopy as the reference standard. **Results:** KOH test was positive in 82.7% of cases. Onycholysis had the highest sensitivity (86.1 %) while jagged edge with spikes demonstrated the highest specificity (88.9%). Onycholysis was significantly associated with KOH positivity (p=0.026), and jagged edge with spikes also showed a highly significant association (p=0.002). The combination of jagged edge and onycholysis yielded an accuracy of 76.9%. Chromonychia (p=0.160) and longitudinal striae (p=0.716) showed weaker associations. **Conclusions:** Specific onychoscopic features, particularly jagged edges with spikes and onycholysis, demonstrated a significant association with KOH positivity. However, given variability in sensitivity and specificity, these findings should be interpreted alongside confirmatory testing (culture or PCR, where available) rather than as standalone diagnostic criteria.

INTRODUCTION

Onychomycosis is a chronic fungal infection of the nails with a global prevalence of 2–13% [1-3]. It is characterized by the invasion of pathogenic fungi into the nail unit. The primary causative agents are dermatophytes such as Trichophyton, Epidermophyton, and Microsporum, with Candida species contributing a smaller proportion [4, 5]. Predisposing factors include prolonged exposure to humid environments, impaired immunity, disturbed peripheral circulation, poor hygiene, and compromised nail integrity due to trauma or pre-existing nail disorders [5, 6]. The main clinical subtypes are distal and lateral subungual onychomycosis (DLSO) involving the distal and lateral edges, proximal subungual onychomycosis (PSO) manifesting as white/yellow patches at the nail base,

DOI: https://doi.org/10.54393/pjhs.v7i8.3925

superficial white onychomycosis presenting as powdery nail surface patches, and total dystrophic onychomycosis (TDO) in which the whole nail is deformed and crumbled [4, 7]. Clinically, onychomycosis manifests with progressive alteration in nail appearance and texture, including brittleness, thickening, discoloration, accumulation of subungual debris, and separation of the nail plate from the underlying nail bed. These changes lead to discomfort, foul odor, pain, functional impairment, and significantly impact the patient's psychological well-being and social interactions [2]. Onychomycosis can be diagnosed using several methods, such as potassium hydroxide (KOH) mount testing, fungal culture, and polymerase chain reaction (PCR) [8-10]. Nail plate KOH test is an inexpensive, rapid method, involving the microscopic examination of nail clippings after treating with KOH solution, which dissolves the nail keratin and preserves the fungal elements [11]. However, KOH testing has limited specificity (38-78%) and relatively high false-negative rates, particularly in early or subtle infections. In contrast, fungal culture is traditionally considered the reference method for confirming the presence of fungal infection but has drawbacks of low sensitivity (31–59%) and requires prolonged incubation time, limiting its utility for immediate diagnosis [12, 13]. PCR is a highly sensitive method, but it is constrained by accessibility due to technical requirements and cost. These limitations highlight the need for more accessible and rapid adjunctive diagnostic approaches. Onychoscopy is a non-invasive diagnostic technique in which a handheld dermoscope (a magnifying device with a built-in light source) is used to examine the nail morphology [14]. The characteristic onychoscopic features include longitudinal striae, jagged edges with spikes, onycholysis, subungual hyperkeratosis, and chromonychia [15]. Onychoscopy helps distinguish different types of onychomycoses as well as differentiate them from other nail disorders [16, 17]. This minimizes the need for unnecessary biopsies while simultaneously optimizing diagnostic accuracy [15, 18]. Accurate and cost-effective diagnostic strategies are essential to prevent misdiagnosis and inappropriate therapy [19, 20].

In resource-limited settings such as Pakistan, confirmatory testing is not routinely available for all patients, which may contribute to inadequate management. Additionally, without laboratory confirmation, treatment failure cannot be reliably differentiated from misdiagnosis. The diagnostic performance of individual onychoscopic features in predicting KOH positivity has not been adequately evaluated in the local population. This study aimed to determine the association between onychoscopic features and nail plate KOH positivity in patients with clinically suspected onychomycosis.

METHODS

This cross-sectional observational study was conducted in the Department of Dermatology, Ghurki Trust Teaching Hospital, Lahore, Pakistan, from 7 August 2025 to 10 January 2026. Ethical approval was obtained from the Institutional Review Board (IRB no: 16981/23 ; dated 9th October 2023). The target population comprised all adult patients presenting with clinically suspected onychomycosis to the Dermatology Outpatient Department during the study period. Sample size of 52 patients was calculated with WHO calculator using the formula $n = Z^2 \times p \times (1 - p) / e^2$, where Z = 1.96 for 95% confidence level, e = 9.4% as margin of error, taken as 0.094, and p = proportion (expressed as a decimal), taken as 0.862 assuming a sensitivity of 86.2% for dermoscopy [2]. Substituting these values: $n = (1.96)^2 \times 0.862 \times (1 - 0.862) / (0.094)^2$, n = 51.7, which was rounded up to 52 participants. Non-probability consecutive sampling was employed. Written informed consent was obtained from all participants. Eligible participants were adults older than 18 years of either sex who presented with clinical features suggestive of onychomycosis, such as nail discoloration, onycholysis, or subungual hyperkeratosis. Patients were excluded if they had pre-existing nail disorders such as psoriasis or lichen planus, onychodystrophy secondary to systemic disease, a history of systemic antifungal therapy within the previous 3 months, or if they were pregnant or lactating. All onychoscopic assessments were performed by a single trained observer to ensure consistency, with no blinding. Onychoscopy was performed using a handheld dermoscope (Heine Delta, 10x magnification) in both non-polarized and polarized modes. Onychoscopic features, including onycholysis, jagged edges with spikes, subungual hyperkeratosis, longitudinal striae, chromonychia, and distal irregular termination, were documented as present or absent and photographed. Following this, nail clippings and subungual debris were collected using a nail clipper and probe. The samples were immersed in 20% KOH solution for 24 hours to facilitate the clearing of thick keratinized tissue to ensure thorough keratin dissolution [21]. Microscopic examination was performed at 10x and 40x magnification for the presence of fungal hyphae or spores. The KOH test results were classified as either positive (presence of fungal structures) or negative (absence of fungal structures).

Data were analyzed using SPSS version 20.0. Categorical variables were summarized as frequencies and percentages. The association between onychoscopic features and KOH test positivity was assessed using Fisher's exact test. Estimation of population parameters was performed by calculating 95% confidence intervals using the exact binomial (Clopper-Pearson) method for

DOI: https://doi.org/10.54393/pjhs.v7i8.3925

sensitivity and specificity. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated to assess diagnostic performance. Combinations of onychoscopic features were evaluated using AND logic (both features had to be present in a patient to be considered positive). A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 52 patients were included, with a female predominance (80.8%). The KOH test was positive in 43/52 cases (82.7%). KOH positivity was observed in 36/42 females (85.7%) and 7/10 males (70%). The results show the distribution of KOH results according to gender. Columns indicate the number of KOH-positive and KOH-negative cases among females (n=42) and males (n=10) (Figure 1).

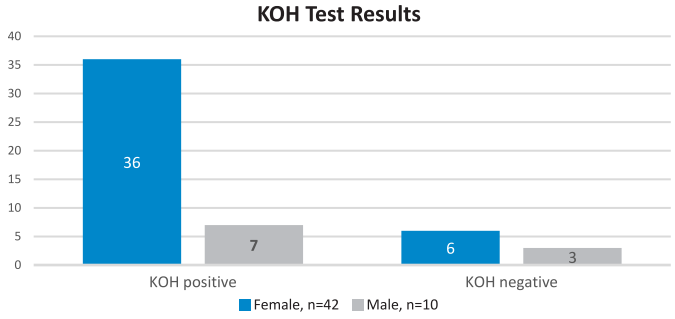


Figure 1: Distribution of KOH Results by Gender

The most common age group was 20 – 30 years. KOH positivity across age groups was 15/17 (88.2%) in 20 – 30 years, 4/6 (66.7%) in 30 – 40 years, 11/15 (73.3%) in 40 – 50 years, 6/6 (100%) in 50 – 60 years, and 7/8 (87.5%) in 60 – 70 years. Distal lateral subungual onychomycosis (DLSO) was the most common clinical subtype, followed by total dystrophic onychomycosis (TDO). KOH positivity varied across clinical subtypes, with 33/37 DLSO cases (89.2%) and 8/11 TDO cases (72.7%) testing positive. Both superficial white onychomycosis (SWO) cases were positive, whereas neither of the two proximal subungual onychomycosis (PSO) cases showed KOH positivity. Demographic and clinical characteristics of study participants are summarized (Table 1).

Table 1: Demographic and Clinical Characteristics of Patients, Including Gender, Age Group (Years), Disease Duration, and Subtype Classification

Parameters	Category	n (%)
Gender	Female	42 (80.8%)
	Male	10 (19.2%)
Age Group (years)	20 – 30	17 (32.7%)
	30 – 40	6 (11.5%)
	40 – 50	15 (28.8%)
	50 – 60	6 (11.5%)
	60 – 70	8 (15.4%)
Disease Duration	<6 Months	14 (26.9%)
	6 – 12 Months	22 (42.3%)
	12 – 24 Months	11 (21.2%)
	>24 Months	5 (9.6%)
Clinical Subtype	Distal and Lateral Subungual Onychomycosis	37 (71.2%)
	Total Dystrophic Onychomycosis	11 (21.2%)
	Proximal Subungual Onychomycosis	2 (3.8%)
	Superficial White Onychomycosis	2 (3.8%)

Among the observed onychoscopic features, onycholysis (76.9%), jagged edge with spikes (67.3%), and chromonychia (55.7%) were the most frequent findings. The findings summarize the frequency distribution of key onychoscopic features stratified by KOH status. Columns show counts of cases with the feature, stratified by KOH status (positive or negative); percentages in parentheses indicate proportion of total sample with that feature (Figure 2).

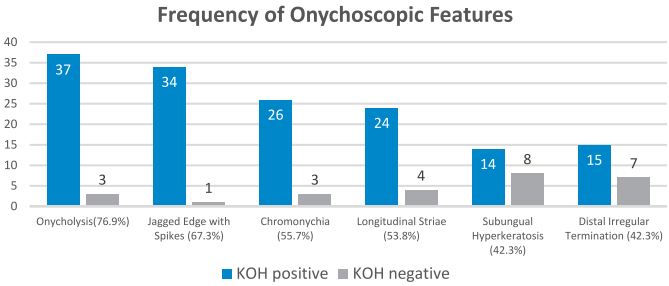
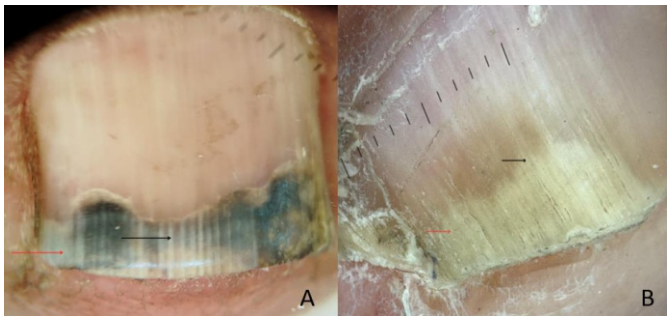


Figure 2: Frequency Distribution and KOH Positivity of Key Onychoscopic Features

Onychoscopic patterns appeared broadly similar across gender and age groups but demonstrated variation across clinical subtypes. DLSO showed higher frequencies of onycholysis (94.6%) and jagged edge with spikes (78.4%), whereas TDO more commonly demonstrated distal irregular termination (90.9%) and subungual hyperkeratosis (72.7%). Interpretation for PSO and SWO was limited due to small case numbers. Representative clinical photographs are provided. (A) Longitudinal striae (black arrow) and distal onycholysis (red arrow). (B) Jagged edges with spikes (black arrow) and distal onycholysis (red arrow). (C) Jagged edges with spikes (black arrow) and distal irregular termination (red arrow). (D) Chromonychia (yellow and black discoloration) (Figure 3).



DOI: https://doi.org/10.54393/pjhs.v7i8.3925

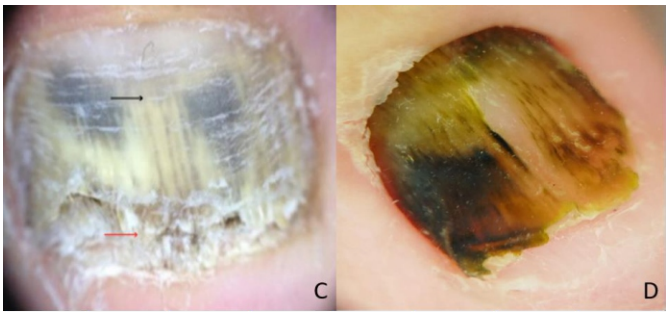


Figure 3: Representative Onychoscopic Images (A-D)

Both onycholysis and jagged edge with spikes demonstrated significant statistical associations with KOH results. Onycholysis showed the highest sensitivity (86.1%), whereas jagged edge with spikes demonstrated the highest specificity (88.9%) and positive predictive value (97.1%). The features like subungual hyperkeratosis and distal irregular termination also showed statistically significant associations; however, both demonstrated low specificity and modest accuracy. Chromonychia showed moderate diagnostic performance (sensitivity 60.5%, specificity 66.7%) and did not demonstrate a strong association with KOH positivity. Longitudinal striae, although frequently observed, showed limited specificity and no statistically significant association with KOH results. Detailed sensitivity, specificity, positive predictive value, negative predictive value, p-values, and diagnostic accuracy for each feature are presented (Table 2).

Table 2: Sensitivity, Specificity, PPV, NPV, and Diagnostic Accuracy for Each Onychoscopic Feature in Comparison with KOH Positivity

Features	Sensitivity % (95% CI)	Specificity % (95% CI)	Positive Predictive Value %	Negative Predictive Value %	p-value	DiagnosticAccuracy %
Jagged Edge with Spikes	79.1 (63.9–89.9)	88.9 (56.5–98.0)	97.1%	47.0%	0.002	80.7%
Onycholysis	86.1 (72.1–94.7)	66.6 (29.9–92.5)	92.5%	50.0%	0.002	82.6%
Longitudinal Striae	55.8 (40.0–70.4)	55.5 (21.2–86.3)	85.7%	20.8%	0.716	55.7%
Subungual Hyperkeratosis	32.5 (20.2–48.0)	11.1 (0.3–48.2)	63.6%	3.3%	0.002	28.8%
Chromonychia	60.4 (44.4–74.9)	66.6 (29.9–92.5)	89.6%	26.1%	0.160	61.5%
Distal Irregular Termination	34.9 (22.9–49.6)	22.2 (2.8–60.0)	68.2%	6.6%	0.026	32.6%

Legend: CI = Confidence Interval

To evaluate whether combinations of multiple features improved predictive performance, predefined combinations were analyzed. Combinations such as onycholysis with jagged edge, longitudinal striae with jagged edge, and onycholysis with chromonychia were evaluated. Among these, the combination of onycholysis and jagged edge demonstrated the highest diagnostic accuracy (76.9%). The study reports the diagnostic performance of combined onychoscopic features using KOH positivity as the reference standard (Table 3).

Table 3: Diagnostic Accuracy of Combined Onychoscopic Features Using and Logic

Combinations	Sensitivity %	Specificity %	Diagnostic Accuracy %
Jagged Edge + Onycholysis	74.4%	88.9%	76.9%
Longitudinal Striae + Jagged Edge	44.2%	88.9%	51.9%
Chromonychia + Onycholysis	53.5%	88.9%	59.6%

Legend: AND Logic = Both features have to be present

DISCUSSION

This study evaluated the association between specific onychoscopic features and KOH positivity in patients with suspected onychomycosis. The observed female predominance (80.8%) in our study may partly be related to socioeconomic factors, including frequent wet work and a greater likelihood of seeking medical care for nail-related cosmetic concerns [22]. The high KOH positivity rate (82.7%) likely reflects the predominance of DLSO, which constituted the majority of cases and demonstrated high positivity (89.2%). The limited number of other subtypes restricts meaningful comparison across clinical patterns. Among individual patterns, jagged edge with spikes demonstrated the highest specificity (88.9%), while onycholysis showed the highest sensitivity (86.1%). Although subungual hyperkeratosis and distal irregular termination showed statistically significant association with KOH positivity, both showed low specificity and modest overall accuracy, limiting their usefulness as standalone predictors. These patterns may reflect non-specific or advanced nail dystrophy rather than definitive fungal infection and should therefore be interpreted cautiously. The combined presence of jagged edge with spikes and onycholysis improved overall accuracy (76.9%), suggesting that clustered feature patterns may enhance predictive association compared with isolated findings. The current study findings align with previously reported diagnostic metrics evaluating individual onychoscopic features. Ma *et al.* reported high overall sensitivity but limited specificity for onychoscopic diagnosis, reflecting variability in predictive strength across features [2]. Similarly, pooled analysis by Lim *et al.* demonstrated high specificity for spike patterns and longitudinal striae, supporting our observation that jagged edges with spikes represent one of the most specific individual findings [19].

DOI: https://doi.org/10.54393/pjhs.v7i8.3925

Minor differences in sensitivity across studies may be attributed to variations in feature definition, inclusion thresholds, and disease severity. Systematic analyses have also highlighted that certain less frequent features may demonstrate very high specificity. Litaiem *et al.* reported extremely high specificity for "ruin appearance", corresponding to distal irregular termination [17]. While statistically significant in our cohort, this pattern was infrequent, limiting its contribution to overall predictive performance. Regional studies have consistently identified spike patterns and longitudinal streaks as common findings [16, 23]. However, our results emphasize that prevalence does not necessarily equate predictive association. Longitudinal striae were frequently observed in our cohort but did not show statistically significant association with KOH positivity, underscoring the need to distinguish between frequency and diagnostic relevance. Similarly, Iorizzo *et al.* reported onycholysis, chromonychia, and subungual hyperkeratosis as the most frequently observed features in their prospective cohort, supporting our observation that commonly encountered patterns do not necessarily demonstrate the strongest predictive association [7]. Comparative approaches incorporating artificial intelligence and clinician-based assessment have demonstrated diagnostic metrics comparable to onychoscopic evaluation [9]. The high specificity for jagged edges with spikes observed in our analysis suggests that targeted evaluation of well-defined patterns may enhance predictive association as compared with generalized pattern recognition. Overall, the current analysis reinforces that individual features contribute differently to predictive strength and clustered feature assessment may provide a reliable association with KOH-confirmed infection.

This study has several limitations that should be considered when interpreting the findings. It was a single-center study with a relatively small sample size, which may limit the statistical power and generalizability of our findings. Future studies would benefit from a multicenter design and a larger sample size to improve robustness. Incorporating multiple observers with inter-observer reliability testing would further enhance reproducibility in feature recognition. Reliance on KOH as the sole confirmatory test may have limited the diagnostic precision, although KOH microscopy remains widely used in clinical practice. Onychoscopy, while valuable for detecting characteristic patterns of onychomycosis, is limited in its ability to differentiate between fungal species or subtypes. Lack of fungal culture or PCR may have affected diagnostic accuracy. Future studies could benefit from combining onychoscopy with these confirmatory tests to improve accuracy. The absence of long-term follow-up also limited insights into pattern evolution and its association with treatment outcomes.

CONCLUSIONS

In this study, specific onychoscopic features demonstrated a significant association with KOH-confirmed onychomycosis, with onycholysis showing high sensitivity and jagged edge with spikes showing high specificity. While these findings highlight the predictive relevance of certain patterns, confirmatory testing, such as fungal culture or PCR, where available, remains essential for diagnosis and treatment planning. Further multicenter studies with larger sample sizes are required to validate these associations in broader populations.

Authors' Contribution

Conceptualization: KT
Methodology: KT, SH, RS
Formal analysis: KT, SH, RS, AH, AAC, IK, HN
Writing and Drafting: KT, SH, RS, AH, AAC, IK, HN
Review and Editing: KT, SH, RS, AH, AAC, IK, HN

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

All the authors declare no conflict of interest.

Source of Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

REFERENCES

[1] González Cortés LF, Prada L, Bonilla JD, Gómez Lopez MT, Rueda LJ, Ibañez E. Onychoscopy in a Colombian Population with a Diagnosis of Toenail Onychomycosis: An Evaluation Study for This Diagnostic Test. Clinical and Experimental Dermatology. 2021 Dec; 46(8): 1427-33. doi: 10.1111/ced.14706.

[2] Ma Y, Ji Y, Cen W, Qiao Z, Gao Y, He L, Feng W. Assessment of the Clinical Diagnosis of Onychomycosis by Dermoscopy. Frontiers in Surgery. 2022 Mar; 9: 854632. doi: 10.3389/fsurg.2022.854632.

[3] Gupta AK, Wang T, Polla Ravi S, Mann A, Lincoln SA, Foreman HC *et al.* Epidemiology of Onychomycosis in the United States Characterized Using Molecular Methods, 2015–2024. Journal of Fungi. 2024 Sep; 10(9): 633. doi: 10.3390/jof10090633.

[4] Abdallah NA, Said M, Mahmoud MT, Omar MA. Onychomycosis: Correlation between the dermoscopic patterns and fungal culture. Journal of Cosmetic Dermatology. 2020 May; 19(5): 1196-204. doi: 10.1111/jocd.13144.

DOI: https://doi.org/10.54393/pjhs.v7i8.3925

[5] Khan SA, Shamsuzzaman SM, Rahman AK, Ashekin NA, Mahmud R, Sharmin R *et al.* Isolation and Identification of Dermatophytes Causing Dermatophytosis at a Tertiary Care Hospital in Bangladesh. Archives of Clinical and Biomedical Research. 2021; 5(3): 437-51.

[6] Sipra MW, Jillian KS, Batool T. Performance Evaluation of Rapid Test Potassium Hydroxide for the Diagnosis of Onychomycosis. The Professional Medical Journal. 2021 Nov; 28(12): 1793-6. doi: 10.29309/TPMJ/2021.28.12.6215.

[7] Iorizzo M, Piraccini BM, Alessandrini A, Bruni F, Vollono L, Pampaloni F *et al.* Clinical and Onychoscopy Patterns in Fingernail Onychomycosis: A Study by the International Dermoscopy Society" Trichoscopy and Onychoscopy" Task Force. Dermatology Practical and Conceptual. 2025; 15(1): 1-6. doi: 10.5826/dpc.1501a4887.

[8] Subathra N and Santhose NB. Evaluation of Diagnostic Efficacy of Two Different Microscopic Techniques and Fungal Culture in Onychomycosis. National Journal of Laboratory Medicine. 2017; 6(3): 5.

[9] Kim YJ, Han SS, Yang HJ, Chang SE. Prospective, Comparative Evaluation of a Deep Neural Network and Dermoscopy in the Diagnosis of Onychomycosis. Plos One. 2020 Jun; 15(6): e0234334. doi: 10.1371/journal.pone.0234334.

[10] Chetana K, Menon R, David BG. Onychoscopic Evaluation of Onychomycosis in a Tertiary Care Teaching Hospital: A Cross-Sectional Study from South India. International Journal of Dermatology. 2018 Jul; 57(7): 837-42. doi: 10.1111/ijd.14008.

[11] Lin YC, Sun PL, Hsiao PF, Sun FJ, Wu YH. Methods for Diagnosing Onychomycosis: A Comparative Study of 459 Cases. Dermatologica Sinica. 2019 Apr; 37(2): 63-6. doi: 10.4103/ds.ds_6_18.

[12] Lipner SR and Scher RK. Onychomycosis: Clinical Overview and Diagnosis. Journal of the American Academy of Dermatology. 2019 Apr; 80(4): 835-51. doi: 10.1016/j.jaad.2018.03.062.

[13] Shakthi R, Venkatesha D. Comparison of KOH, Calcofluor White, and Fungal Culture in the Diagnosis of Onychomycosis. International Journal of Current Microbiology and Applied Sciences. 2019; 8: 1420-5. doi: 10.20546/ijcmas.2019.807.169.

[14] Ankad BS, Gupta A, Alekhya R, Saipriya M. Dermoscopy of Onycholysis Due to Nail Psoriasis, Onychomycosis, and Trauma: A Cross-Sectional Study in Skin of Color. Indian Dermatology Online Journal. 2020 Sep; 11(5): 777-83. doi: 10.4103/idoj.IDOJ_475_19.

[15] Nada EE, El Taieb MA, El-Feky MA, Ibrahim HM, Hegazy EM, Mohamed AE *et al.* Diagnosis of Onychomycosis Clinically by Nail Dermoscopy Versus Microbiological Diagnosis. Archives of Dermatological Research. 2020 Apr; 312(3): 207-12. doi: 10.1007/s00403-019-02008-6.

[16] Bhat YJ, Mir MA, Keen A, Hassan I. Onychoscopy: An Observational Study in 237 Patients from the Kashmir Valley of North India. Dermatology Practical and Conceptual. 2018 Oct; 8(4): 283. doi: 10.5826/10.5826/dpc.0804a06.

[17] Litaiem N, Mnif E, Zeglaoui F. Dermoscopy of Onychomycosis: A Systematic Review. Dermatology Practical and Conceptual. 2023 Jan; 13(1): e2023072. doi: 10.5826/dpc.1301a72.

[18] Hazarika N, Chauhan P, Kansal NK, Bahurupi YA. Onychoscopy: A Quick and Effective Tool for Diagnosing Onychomycosis in a Resource-Poor Setting. Acta Dermatovenerologica Alpina, Pannonica et Adriatica. 2021 Jan; 30(1): 11-5. doi: 10.15570/actaapa.2021.3.

[19] Lim SS, Hui L, Ohn J, Cho Y, Oh CC, Mun JH. Diagnostic Accuracy of Dermoscopy for Onychomycosis: A Systematic Review. Frontiers in Medicine. 2022 Oct; 9: 1048913. doi: 10.3389/fmed.2022.1048913.

[20] Kaynak E, Göktay F, Güneş P, Sayman E, Turan D, Baygül A *et al.* The Role of Dermoscopy in the Diagnosis of Distal Lateral Subungual Onychomycosis. Archives of Dermatological Research. 2018 Jan; 310(1): 57-69. doi: 10.1007/s00403-017-1796-2.

[21] Shavandi A, Silva TH, Bekhit AA, Bekhit AE. Keratin: Dissolution, Extraction and Biomedical Application. Biomaterials Science. 2017; 5(9): 1699-735. doi: 10.1039/C7BM00411G.

[22] Lipner SR, Falotico JM, Konda A. Based on Sex: Impact and Treatment of Toenail Onychomycosis in Female Patients. The Journal of Clinical and Aesthetic Dermatology. 2023 Oct; 16(10): 52.

[23] Yorulmaz A and Yalcin B. Dermoscopy as a First Step in the Diagnosis of Onychomycosis. Advances in Dermatology and Allergology. 2018 Jun; 35(3): 251-8. doi: 10.5114/ada.2018.76220.