Dermatology Practical & Conceptual

Evaluation of the Knowledge of Primary Care Physicians About Important Nail Diseases Before and After a Short Online Training

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ABSTRACT

Introduction: Nail diseases are often diagnosed late with a potential prognostic and functional impact. This could be partly due to knowledge gaps among primary care physicians (PCPs).

Objectives: To evaluate the knowledge about diagnosis and management of ten common/important nail conditions in a population of French PCPs and its improvement after a 31-minute online training session.

Methods: We submitted 10 pre-test and post-test clinical cases and an educative online course on the diagnosis and the management of nail diseases to 138 volunteer PCPs; 73 completed the whole training path.

Results: Compared to pre-test, more PCPs in the post-test required an urgent second opinion to dermatologist for pigmented melanoma (100% versus 80.3%; P <0.05) and use of inappropriate/dangerous systemic treatment for trauma-induced nail changes was reduced after the training program (0% versus 6.8%; P <0.05). A lack of knowledge remained after training for amelanotic melanoma with an increase of mycological/bacteriological tests (9.6% versus 0%; P <0.05).

Conclusions: Management of nail diseases by our panel of PCPs was suboptimal and was improved after a short online training.

Introduction

Nail disorders are very common but might not be very well-known by primary care physicians (PCPs). Although 50% of nail conditions are due to fungal infection, other diseases affecting the nail unit are neoplastic, inflammatory, congenital, traumatic, or related to a systemic disease. Because some of these non-fungal conditions clinically look alike onychomycoses, their diagnosis is often missed. Patients may be then exposed to diagnostic delays with important prognostic significance especially in malignant tumors such as subungual melanoma (SUM) or subungual squamous cell carcinoma (SSCC) [1]. Moreover, they are often submitted to inappropriate treatments. Many publications underline that diagnosis of SUM can be delayed from 9 months to 2.2 years after occurrence of the first symptoms [2,3]. These diagnostic delays are responsible in part of the apparent worse prognosis of SUM yet, for an equivalent Breslow index, their prognosis is not different from that observed in melanoma occurring elsewhere on skin [4]. Confounding various nail conditions with fungal infection also led to an inappropriate use of medical resources such as urgent dermatology consultations, imaging, mycology tests and to unnecessary use of antifungal drugs. This is particularly true with repetitive trauma-induced toenail changes due to the conflict between the shoe and the tiptoes. This condition not only looks like fungal infection but is also frequently contaminated with fungus, therefore identifiable by laboratory tests [5]. In such cases, antifungal treatment may show some improvement that is rarely complete and often followed by a relapse since the real cause of the nail change is underestimated. Moreover, subungual glomus-cell tumor (SGCT), a sometimes very painful benign tumor, is known to be frequently left untreated for as long as 1 to 9 years with significant risk of disability and depression [6,7].

Objectives

The main objectives of our study were to evaluate the potential lack of knowledge of PCPs about common or prognostically/functionally important nail diseases, to propose an online teaching session and to evaluate its improvement, particularly under the perspective of a better use of medical and therapeutic resources. Our secondary goal was to evaluate pieces of knowledge where the improvements were the most significant and to identify topics in which our teaching program could be improved.

Methods

Study Design

We conducted a blinded anonymous study on 138 PCPs over a three-month period from November 2020 to January 2021. This study was approved by the Ethical Committee of the Université Claude Bernard Lyon 1 (Institutional Review Board N°2020-07-07-08, on July the 7th in 2020).

We sent by e-mail a web link leading to our online educative path to all PCPs members of the URPS union of Auvergne/Rhone-Alpes region and Grand Est region hosted by Claroline®, the official educational website of Lyon 1 Claude Bernard University. It was first composed of a 10-clinical-case pre-test, followed by a 31-minute educative video (https://clarolineconnect.univ-lyon1.fr/resource/open/file/4776658 in French) and lastly a distinct 10-case post-test. The link for the post-test was only available when the applicant had validated the pre-test and completely watched the educative video. Pre- and post-test, for each case, included a multiple-choice question with pre-determined answers about management and a single choice question with pre-determined answer for the diagnostic orientation. Both pre- and post-test included distinct cases of one pigmented SUM, one amelanotic SUM, one SSCC, one trauma-induced nail change, one onychomycosis, one nail unit psoriasis, one SGCT, one nail case of alopecia areata, one periungual viral wart and one subungual hemorrhage. Management proposals for each case were (one or more answer boxes could be ticked): "clinical follow-up", "radiology imaging", "mycological or bacteriological test", "non-urgent dermatologist second opinion", "orthopedic surgeon second opinion", "podiatrist consultation", "topical antifungal", "other topical treatment", "systemic treatment", and "urgent dermatologist second opinion". The diagnostic proposal for each case (only one answer box could be ticked) were the 10 conditions listed above. During the teaching video, all these conditions were covered by vocal explanations and images of several examples and five simple rules to improve diagnostic strategy in nail disease was taught : (1) thinking about nail tumor when a condition is monodactylic, (2) referring to dermatologist for brown or black but also red or white-yellowish longitudinal nail band, (3) spontaneous nail plate erosion is not banal, (4) referring to dermatologist for non resolutive and painful nail condition and (5) evaluate the static and the dynamic of feet for toenail disease.

The answers to the pre- and the post-test were pre-determined before the launch of the educative program by a consensus of nail diseases experts and were classified as "compulsory" (+15 points), "correct" (0 points), "acceptable" (-5 point), "inappropriate" (-10 points) or "dangerous" (-30 points). An example of "compulsory" answer was an urgent dermatologist second opinion for pigmented or amelanotic SUM or podiatrist consultation in case of trauma-induced nail change. An example of "dangerous answer" was clinical follow-up for SSCC. For onychomycosis and psoriasis, no "dangerous" management were considered. An example of "acceptable" answer was an orthopedic

surgeon second opinion for SUM, an example of "inappropriate" answer was imaging for nail psoriasis. Although our study was more focused on the management of the cases, diagnostic orientation was also evaluated during pre- and post-tests. A correct answer was given 5 points. Rating for all answers was discussed with our biostatistician (GD).

Some other common nail conditions were also briefly covered during the course (ingrown nail, pyogenic granuloma, mucoid pseudocyst, ungual changes in systemic disease, onychotillomania and some benign nail tumors). All cases shown during the pre-test were included in the teaching examples during the video course and expected answers to the questionnaire were then disclosed for each. Indeed, none of the cases used for the post-test were included in the video as examples.

Study Population

Participating PCPs were asked about their gender, age, geographic setting (urban, suburban, or rural area), number of years after initial medical certification, attendance to post-university training session dermatology during the last 2 years. Although we had the results of the pre-test of all the enrolled population, we only retained for statistical analysis the 73 for whom we had the complete sequence of tests and training. The 65 PCPs who did not completed the entire study were only compared to the 73 others to determine if the two populations could be any different.

Statistics

Statistical analysis was performed by an independent biostatistician (GD) who also reviewed the questionnaire before its online launch. Statistical unit was the PCP. Statistical analysis was conducted using the IBM IPSS Statistic software, version 19 (IBM). Distribution comparisons were made by the Chi-2 test, Fisher test for qualitative variables, Student t test or paired Student t test for quantitative variables. P value <0.05 was considered significant.

Results

Training path web link was sent to 10,205 PCPs. One hundred and thirty-eight PCPs were initially enrolled in the study and finished the pre-test. However, only 73 (52.9%) among them completed the whole training program. Comparison with national statistics disclosed that our tested population, as usual in many medical surveys, included a slightly higher number of female (51/73 (69.3%); P = 0.0007) and younger (<40 years-old) (40/73 (54.7%); P = 1.0 10^{-12}) PCPs than found in their general population in France.

Comparing each PCP with himself, we demonstrated that the pre-test mean score was 15.2/20 and raised to 16.9/20 in the post-test (P = 2.25 10^{-18}). Comparison of the pre-test scores of the participants who did not complete the whole training path to the others did not show significant difference.

When comparing pre and post-test, the number of compulsory and correct answers was significantly higher in the post-test. For management, the correct answer (ie "clinical follow up") raised from 6/73 (8.2%) to 19/73 (26%) in warts (P=0.002), from 16/73 (21.9%) to 33/73 (45.2%) in trauma-induced nail changes (P = 0.002; Table 1).

A podiatrist consultation for trauma-induced nail changes was proposed in only 13/73 (17.8%) of the pre-test but raised to 55/73 (75.3%) in the post-test (P < 0.001). For pigmented SUM, 59/73 (80.3%) of PCPs required an urgent dermatologist second opinion in the pre-test whereas all recommended it 73/73 (100%) in the post-test (P < 0.001; Table 1).

In onychomycosis, the choice of a systemic treatment was made by 16/73 (21.9%) PCPs in the pre-test while 54/73 (74%) prescribed it in the post-test (P < 0.001). For SGCT, the use of radiology imaging raised from 18/73 (24.7%) in the pre-test to 43/73 (58.9%) in the post-test (P < 0.001; Table 1).

We also observed a decrease of using dangerous management in the post-test especially in malignant tumors. Seven dangerous managements were initially proposed in the pre-test (4/73 in SSCC, 2/73 in amelanotic SUM and 1/73 in pigmented SUM) then was reduced to 3 after completion of the training program (3/73 in amelanotic SUM), (P = 0.324; Table 3).

The use of inappropriate/dangerous systemic treatment was reduced after the training program: from 4/73 (5.5%) to 1/73 (1.4%) in warts (P = 0.085); and from 18/73 (24.7%) to 10/73 (13.7%) in alopecia areata (P = 0.045; Table 3).

A decrease in the unnecessary consumption of medical resources was also observed (Table 4). Mycological/bacteriological tests decreased after the training program: from 29/73 (39.7%) to only 3/73 (4.1%) in warts (P < 0.001) and from 40/73 (54.8%) to 4/73 (5.5%) in trauma-induced nail changes (P < 0.001). Moreover, emergency referral (urgent second opinion) to dermatologists decreased from 20/73 (27.4%) to 5/73 (6.2%) (P < 0.001) and from 6/73 (8.2%) to 0% (P = 0.005) in subungual hemorrhage and alopecia areata respectively.

Of note, the number of mycological/bacteriological tests slightly increased in the post-test (Table 4): 0/73 versus 7/73 (9.6%) in case of amelanotic SUM (P = 0.03). Similarly, the number of prescriptions of topical antifungals as well as the number of urgent dermatologist referrals slightly increased in the post-test in case of nail psoriasis (Table 4): 4/73 (5.5%) versus 1/73 (1.4%) (P = 0.085) and 2/73 (2.7%) versus 0/73 (P = 0.076) respectively, which was not statistically significant. We can however observe that the post-test

Table 1. Pre-to-post-test evolution of correct or compulsory management answers in the panel.

Nail disorders	Correct or compulsory answers, N (%)		P value
	Pre-test (N = 73)	Post-test (N = 73)	
Wart			
Clinical follow-up	6 (8.2)	19 (26.0)	0.002
Trauma-induced nail change			
Clinical follow-up	16 (21.9)	33 (45.2)	0.001
Podiatrist consultation	13 (17.8)	55 (75.3)	0.001
Onychomycosis			
Mycological or bacteriological test	36 (49.3)	53 (72.6)	0.001
Non-urgent dermatologist second opinion	27 (37.0)	13 (17.8)	0.004
Systemic treatment	16 (21.9)	54 (74.0)	< 0.001
Squamous cell carcinoma			
Radiology imaging	16 (21.9)	22 (30.1)	0.128
Urgent dermatologist second opinion	56 (76.7)	66 (90.4)	0.012
Amelanotic nail melanoma			
Radiology imaging	39 (53.4)	14 (19.7)	<0.001
Urgent dermatologist second opinion	71 (97.3)	68 (93.2)	0.122
Glomus tumor			
Radiology imaging	18 (24.7)	43 (58.9)	<0.001
Non-urgent dermatologist second opinion	43 (58.9)	41 (56.2)	0.369
Subungual hemorrhage			
Clinical follow-up	52 (71.2)	60 (82.2)	0.057
Pigmented subungual melanoma			
Urgent dermatologist second opinion	59 (80.3)	73 (100)	<0.001
Alopecia areata			
Non-urgent dermatologist second opinion	53 (72.6)	61 (83,6)	0.053
Psoriasis			
Non-urgent dermatologist second opinion	58 (79.5)	60 (82,2)	0.337
Systemic treatment	11 (15.1)	10 (13,7)	0.407

case of psoriasis nail could have been found more difficult to identify by the panel of PCPs since it was correctly diagnosed in only 45/73 (61.6%) versus 72/73 (98.6%) for the pre-test (P < 0.001) (Table 2). Lastly, in case of nail unit wart, the rate of urgent dermatologist referral increased from 12/73 (16.4%) to 23/73 (31.5%) (P = 0.015) after the training as well as the use of radiology imaging which increase from 3/73 (4.1%) to 13/73 (17.8%) (P = 0.003) (Table 4).

Conclusions

Most of the studies about SUM, SSCC and, to a lesser extent, SGCT, underline that diagnostic delay is often long and generates losses of chance for curative and functional surgery in the two cancers and an unnecessary long delay towards functional and pain relief in the latter case. SUM is frequently discovered at advanced stage and the average reported delay to initial treatment often long, from 15 months to 30 years [8,9]. SSCC, s also often diagnosed late, from 2 to 480 months (mean : 55 months) [10]. These important delays might be partially responsible of an apparent worse prognosis of SUM with a 33% overall survival rate at 15 years. Moreover, since conservative surgical treatments can be offered to early-stage SUM and SSCC, these delays could also result in a higher number of amputations and subsequent disabilities [11,12].

Part of the problem could be initial wrong management strategies by PCPs [13]. However, little is known in the literature about the global knowledge of PCPs about common or functionally important nail diseases [14-16]. For unknown reasons, the most widely acknowledged nail conditions by health professionals are fungal infections. Indeed, many onychomycoses do exist since it is claimed that about 10 to 50% of all nail diseases could be due to dermatophytic nail bed

Table 2. Pre-to-post test evolution of correct diagnosis in the panel.

	Correct diagnosis, N (%)		P value
	Pre-test (N = 73)	Post-test (N = 73)	
Wart	19 (26.0)	31 (42.5)	0.017
Trauma-induced nail change	24 (32.9)	70 (95.9)	<0.001
Onychomycosis	44 (60.3)	72 (98.9)	<0.001
Squamous cell carcinoma	12 (16.4)	28 (38.4)	0.001
Amelanotic subungual melanoma	12 (16.4)	34 (46.6)	<0.001
Glomus tumor	49 (67.1)	56 (76.7)	0.097
Subungual hemorrhage	53 (72.6)	68 (93.2)	<0.001
Pigmented subungual melanoma	62 (84.9)	71 (97.3)	0.004
Alopecia areata	49 (67.1)	48 (65.8)	0.430
Psoriasis	72 (98.6)	45 (61.6)	<0.001

Table 3. Pre-to-post test evolution of "dangerous" management in the panel.

	"Dangerous" answer, N (%)		P value
	Pre-test (N = 73)	Post-test (N = 73)	
Wart			
Systemic treatment	4 (5.5)	1 (1.4)	0.085
Trauma-induced nail change			
Systemic treatment	5 (6.8)	0	0.010
Squamous cell carcinoma			
Clinical follow-up	2 (2.7)	0	0.076
Topical antifungal	0	0	NA
Other topical treatment	1 (1.4)	0	0.157
Systemic treatment	1 (1.4)	0	0.157
Amelanotic nail melanoma			
Clinical follow-up	0	0	NA
Non-urgent dermatologist second opinion	2 (2.7)	3 (4.1)	0.324
Topical antifungal	0	0	NA
Other topical treatment	0	0	NA
Systemic treatment	0	0	NA
Glomus tumor			
Systemic treatment	0	0	NA
Subungual hemorrhage			
Systemic treatment	0	0	NA
Pigmented nail melanoma			
Clinical follow-up	1 (1.4)	0	0.157
Alopecia areata			
Systemic treatment	18 (24.7)	10 (13.7)	0.045

NA = not applicable.

invasion [17]. However, many authors believe that this condition is often not the primary nail disease and that many of them in fact complicate a pre-existing nail disease or injury [18]. Damaged nail by inflammatory nail disease like psoriasis are often secondarily contaminated by dermatophytes that can subsequently be evidenced in the nail table by mycological laboratory tests [19,20]. Trauma-induced nail changes are much more common on toenails with the exception of onychotillomania. Evaluation of nail disease must always be done keeping in mind that any trouble of the foot static or any use of traumatizing shoes can result in nail injury and chronic changes too often confused with nail fungal infection.

Table 4. Pre-to-post-test evolution of inappropriate use of medical resources in the panel.

	Incorrect answer, N (%)		P-value
	Pre-test (N = 73)	Post-test (N = 73)	
Wart			
Radiology imaging	3 (4.1)	13 (17.8)	0.003
Mycological or bacteriological test	29 (39.7)	3 (4.1)	<0.001
Urgent dermatologist second opinion	12 (16.4)	23 (31.5)	0.015
Trauma-induced nail change			
Radiology imaging	0	0	NA
Mycological or bacteriological test	40 (54.8)	4 (5.5)	<0.001
Topical antifungal	37 (50.7)	1 (1.4)	<0.001
Urgent dermatologist second opinion	1 (1.4)	1 (1.4)	0.500
Onychomycosis			
Radiology imaging	3 (4.1)	1 (1.4)	0.154
Orthopedic surgeon second opinion	0	0	NA
Urgent dermatologist second opinion	4 (5.5)	2 (2.7)	0.202
Squamous cell carcinoma			
Mycological or bacteriological test	9 (12.3)	1 (1.4)	0.004
Amelanotic nail melanoma			
Mycological or bacteriological test	0	7 (9.6)	0.003
Glomus tumor			
Mycological or bacteriological test	1 (1.4)	0	0.157
Topical antifungal	0	0	NA
Subungual hemorrhage			
Radiology imaging	6 (8.2)	2 (2.7)	0.071
Mycological or bacteriological test	1 (1.4)	0	0.157
Orthopedic surgeon second opinion	1 (1.4)	0	0.157
Urgent dermatologist second opinion	20 (27.4)	5 (5.8)	<0.001
Pigmented nail melanoma			
Mycological or bacteriological test	1 (1.4)	0	0.157
Alopecia areata			
Radiology imaging	1 (1.4)	1 (1.4)	0.500
Mycological or bacteriological test	14 (19.2)	8 (11)	0.081
Topical antifungal	3 (4.1)	0	0.038
Urgent dermatologist second opinion	6 (8.2)	0	0.005
Psoriasis			
Radiology imaging	2 (2.7)	0	0.076
Topical antifungal	1 (1.4)	4 (5.5)	0.085
Urgent dermatologist second opinion	0	2 (2.7)	0.076

NA = not applicable.

We believe that a wider diffusion of five simple rules can avoid many misdiagnoses: (1) thinking about nail tumor when a condition is monodactylic, (2) referring to dermatologist for brown or black but also red or white-yellowish longitudinal nail band, (3) spontaneous nail plate erosion is not banal, (4) referring to dermalogist for non resolutive and painful nail condition and (5) evaluate the static and the dynamic of feet for toenail disease and eventually refer to a podiatrist.

Our study showed a global poor level of knowledge with a relatively high frequency of inappropriate proposed management. We also observed a misuse of medical resources in

many benign conditions. In our view, the rate of pre-test misdiagnoses does not reflect the current practice of nail consultations in our department and cannot completely explain the observed management delays especially for nail unit cancers. This might be due to a recruitment bias since we cannot exclude that the volunteer participants chose to enter the study because of their specific interest in onychology. However, we observed significant improvement in the management strategies of most tested conditions.

Some points could deserve a revision of our teaching strategy: more thorough training for amelanotic SUM seems to be necessary. However, this diagnosis often remains difficult even for trained dermatologists. High level of prescription of radiology imaging and urgent dermatology consultation in nail unit viral warts appears to be an unexpected unwanted effect of the sensibilization of our public about the diagnosis of SSCC. We do not consider this as a poor outcome of our training program since it is always better to insist on the possible malignant counterpart. Maybe an age and disease-duration threshold could be proposed in our teaching to help counter this effect.

Our study has several possible biases. Our sample did not reflect the general population of French PCPs since women were overrepresented and our population was younger. This is a common finding in medical practice surveys and probably reflect the greater interest for online educational tools of young health professionals, who are more often women in our country. As mentioned earlier, we cannot exclude a selection bias, yet our questionnaire revealed that only few of them had received a specific training in dermatology in general and on nail diseases during the two previous years. A framing bias cannot be excluded since our teaser message to enter the study specifically mentioned the risk of misdiagnosing nail unit cancer in general and SUM in particular.

In conclusion, correct diagnosis of a nail disease can be delayed especially in primary care. Onychomycosis is often over-diagnosed, since there is a lot of commercial communication about it. A short online training focusing on five simple rules significantly improved the management abilities of several nail conditions including life threatening ones by PCPs.

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References

1. Lipner SR, Scher RK. Onychomycosis – a small step for quality of care. *Curr Med Res Opin.* 2016;.;32(5):865-867. DOI: 10.1185/03007995.2016.1147026. PMID: 26807603.
2. Nguyen JT, Bakri K, Nguyen EC, Johnson CH, Moran SL. Surgical management of subungual melanoma: mayo clinic experience of 124 cases. *Ann Plast Surg.* 2013;71(4):346-354. DOI: 10.1097/SAP.0b013e3182a0df64. PMID: 24025653.
3. Wollina U, Tempel S, Hansel G. Subungual melanoma: A single center series from Dresden. *Dermatol Ther.* 2019;32(5):e13032. DOI: 10.1111/dth.13032. PMID: 31344289.
4. Phan A, Touzet S, Dalle S, Ronger-Savlé S, Balme B, Thomas L. Acral lentiginous melanoma: a clinicoprognostic study of 126 cases. *Br J Dermatol.* 2006;155(3):561-569. DOI: 10.1111/j.1365-2133.2006.07368.x. PMID: 16911282.
5. Natarajan V, Nath AK, Thappa DM, Singh R, Verma SK. Coexistence of onychomycosis in psoriatic nails: a descriptive study. *Indian J Dermatol Venereol Leprol.* 2010;76(6):723. DOI: 10.4103/0378-6323.72468. PMID: 21079333.
6. Girisha BS, Shenoy MM, Mathias M, Mohan R. Glomus tumor of the nail unit. *Indian J Dermatol.* 2011;56(5):583-584. DOI: 10.4103/0019-5154.87163. PMID: 22121286. PMCID: PMC3221231.
7. Jawalkar H, Maryada VR, Brahmajoshyula V, Kotha GK. Subungual glomus tumors of the hand: Treated by transungual excision. *Indian J Orthop.* 2015;49(4):403-407. DOI: 10.4103/0019-5413.159611. PMID: 26229160. PMCID: PMC4510793.
8. Chakera AH, Quinn MJ, Lo S, Drummond M, et al. Subungual Melanoma of the Hand. *Ann Surg Oncol.* 2019;26(4):1035-1043. DOI: 10.1245/s10434-018-07094-w. PMID: 30565042.
9. Talavera-Belmonte A, Bonfill-Ortí M, Martínez-Molina L, et al. Subungual Melanoma: A Descriptive Study of 34 Patients. Actas Dermosifiliogr (Engl Ed). 2018;109(9):801-806. DOI: 10.1016/j.ad.2018.06.010. PMID: 30082026.
10. Dijksterhuis A, Friedeman E, van der Heijden B. Squamous Cell Carcinoma of the Nail Unit: Review of the Literature. *J Hand Surg Am.* 2018;43(4):374-379.e2. DOI: 10.1016/j.jhsa.2018.01.010. PMID: 29482957.
11. Sureda N, Phan A, Poulalhon N, Balme B, Dalle S, Thomas L. Conservative surgical management of subungual (matrix derived) melanoma: report of seven cases and literature review. *Br J Dermatol.* 2011;165(4):852-858. DOI: 10.1111/j.1365-2133.2011.10477.x. PMID: 21812768.
12. Topin-Ruiz S, Surinach C, Dalle S, Duru G, Balme B, Thomas L. Surgical Treatment of Subungual Squamous Cell Carcinoma by Wide Excision of the Nail Unit and Skin Graft Reconstruction: An Evaluation of Treatment Efficiency and Outcomes. *JAMA Dermatol.* 2017;153(5):442-448. DOI: 10.1001/jamadermatol.2017.0014. PMID: 28384651. PMCID: PMC5817490.
13. Papachristou DN, Fortner JG. Melanoma arising under the nail. *J Surg Oncol.* 1982;21(4):219-222. DOI: 10.1002/jso.2930210405. PMID: 7144198.
14. Iorizzo M. Tips to treat the 5 most common nail disorders: brittle nails, onycholysis, paronychia, psoriasis, onychomycosis. *Dermatol Clin.* 2015;33(2):175-183. DOI: 10.1016/j.det.2014.12.001. PMID: 25828710.

15. Schneider SL, Tosti A. Tips to diagnose uncommon nail disorders. *Dermatol Clin*. 2015;33(2):197-205. DOI: 10.1016/j.det.2014.12.003. PMID: 25828712.
16. Maddy AJ, Tosti A. What's New in Nail Disorders. *Dermatol Clin*. 2019;37(2):143-147. DOI: 10.1016/j.det.2018.12.004. PMID: 30850036.
17. Thomas J, Jacobson GA, Narkowicz CK, Peterson GM, Burnet H, Sharpe C. Toenail onychomycosis: an important global disease burden. *J Clin Pharm Ther.* 2010;35(5):497-519. DOI: 10.1111/j.1365-2710.2009.01107.x. PMID: 20831675.
18. Dalle S, Depape L, Phan A, Balme B, Ronger-Savle S, Thomas L. Squamous cell carcinoma of the nail apparatus: clinicopathological study of 35 cases. *Br J Dermatol.* 2007;156(5):871-874. DOI: 10.1111/j.1365-2133.2006.07744.x. PMID: 17263801.
19. Elewski BE. Onychomycosis: pathogenesis, diagnosis, and management. *Clin Microbiol Rev.* 1998;11(3):415-429. DOI: 10.1128/CMR.11.3.415. PMID: 9665975. PMCID: PMC88888.
20. Summerbell RC, Cooper E, Bunn U, Jamieson F, Gupta AK. Onychomycosis: a critical study of techniques and criteria for confirming the etiologic significance of nondermatophytes. *Med Mycol.* 2005;43(1):39-59. DOI: 10.1080/13693780410001712043. PMID: 15712607.