Review Article

Ultraviolet-Induced Fluorescence Dermoscopy, a Novel Diagnostic Technique in Dermatological Practice: A Systematic Review

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Abstract

Introduction: Ultraviolet-induced fluorescence dermoscopy (UVF dermoscopy) is a novel diagnostic technique for identifying and diagnosing numerous skin tumors, inflammatory dermatoses, and infectious diseases. The ultraviolet (UV) band has a wavelength ranging from 10 to 400 nm. When intense UV radiation with shorter wavelengths strikes a target chromophore, visible light (VL) with a longer wavelength and lower energy is produced in the skin. This VL is apparent to the naked eye and is referred to as fluorescence. **Aim:** The current review compares ultraviolet fluorescence dermoscopy (UVFD) and polarized dermoscopy (PD) features in various dermatological disorders. **Materials and Methods:** This review was performed in accordance with PRISMA (Preferred Reporting Items for Systematic Reviews and Metanalyses) guidelines. A comprehensive search of the literature was carried out through the PubMed and Google Scholar electronic databases from inception to 25th December 2023 using the following search terms: "UV dermoscopy" OR "ultraviolet fluorescence dermoscopy" OR "ultraviolet-induced fluorescence dermoscopy" OR "Ultraviolet-induced fluorescent dermoscopy". Titles, abstracts, and full texts were screened by two independent reviewers to select papers dealing with UVF-dermoscopy. **Results:** A total of 23 relevant articles were included in this systematic review, including a total of 313 patients. Pigmented skin tumors included 209 patients, Fordyce spot mimickers (13), scabies (57), biopsy site (20), psoriasis (3), corynebacterium infections (2), fungal infections (4), vitiligo (3), acne folliculitis (1) and glomus tumors (1). Levels of evidence (LoE) was 3 and 4 in only two included studies; the rest had a LoE of 5. **Discussion:** UVF dermoscopy is a new diagnostic and prognostic tool for neoplastic and non-neoplastic dermatological conditions. This is the first systematic review of its sort that compares and categorizes dermoscopic findings in UVF and polarized light in dermatological practice. As UVFD does not penetrate deeper skin layers, we observed that it is a better way to distinguish features restricted to the skin's superficial layers in neoplastic diseases. As a result, tumor-free margins and improved surgical outcomes can be achieved. More favorable outcomes for evaluation and treatment were seen with non-neoplastic conditions. Limitations included a lack of studies with a high level of evidence, control groups, and larger sample sizes. **Conclusion:** We concluded that UVFD will improve clinical diagnosis, disease management, and outcomes. More clinical trials with larger sample sizes are recommended to better understand this novel and intriguing new diagnostic tool.

Keywords: *Dermoscopy, fluorescence, pigmented skin tumors, ultraviolet light, Wood's lamp*

Introduction

Ultraviolet-induced fluorescence dermoscopy (UVF dermoscopy) is a novel technique that has become a miniature portable Wood's lamp device capable of diagnosing numerous skin tumors, inflammatory dermatoses, and infectious diseases.[1,2] It employs a UV-light source to evoke fluorescence by skin chromophores based on the Stokes shift phenomenon, with possible consequent detection of UV-induced fluorescent findings.[3] Primarily used to detect pigmentary skin tumors such as malignant melanoma (MM), melanocytic nevus (MN), basal cell carcinoma (BCC), and seborrheic keratosis (SK), its application in diagnosing other dermatological disorders, such as psoriasis, scabies, lichen planus, vitiligo, granulomatous diseases, disorders of keratinization, sebaceous gland disorders, and bacterial and fungal infections, has recently expanded.[1]

How to cite this article: Bhat YJ, Ul Islam MS, Errichetti E. Ultraviolet-induced fluorescence dermoscopy, a novel diagnostic technique in dermatological practice: A systematic review. Indian Dermatol Online J 2025;16:25-39.

Received: 01-Apr-2024. **Revised:** 26-May-2024. **Accepted:** 03-Jul-2024. **Published:** 13-Dec-2024.

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Access this article online

Website: https://journals.lww.com/idoj

DOI: 10.4103/idoj.idoj_299_24

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Electromagnetic spectrum, fluorescence mechanism, and Stokes shift phenomenon

The electromagnetic spectrum can be described by the entire range of spectra that can be separated into different bands based on their wavelengths or frequencies. From low to high frequency, they are radio waves, microwaves, infrared, visible light, ultraviolet, X-rays, and gamma rays [Figure 1a]. The only light discernible with the naked eye falls in the 400-700 nm range. The ultraviolet range band, which is applicable in dermatological diagnostics, includes wavelengths ranging from 10 to 400 nm[2,4] [Figure 1b].

When an energetic UV light with shorter wavelengths strikes a target chromophore in the skin, a visible light (VL) with lower energy and longer wavelength is generated, which can be perceived by the naked eye. This phenomenon that results in fluorescence emission is called the Stokes shift phenomenon. It is hypothesized that when a chromophore becomes active, electrons acquire an unstable state from their ground state and cannot stay there for long; consequently, they attempt to return to their ground state. As a result, there is a vibrational relaxation, and the energy decay process results in the emission of photons recognized as visible light (fluorescence).[3,4] A schematic picture of the emission of visible light upon UV light exposure on the target chromophore is described in Figure 1c.

Dermatological application of ultraviolet light

Robert W in 1903, generated a low-pressure mercury arc light that emitted radiation (320-450 nm) and termed it Woods light. When exposed to UV light, both endogenous and exogenous chromophores emit fluorescence, which aids in their detection by visual inspection. Other devices exhibiting comparable characteristics include light-emitting diodes (LED), fluorescent light bulbs, and blacklight blue bulbs, which emit UV light similar to Wood's lamp.[1,2,4] It has been used to diagnose a wide range of dermatological diseases, including bacterial infections, fungal infections, hypopigmented, and metabolic conditions.[1] UV imaging methods include direct visualization of UV-induced fluorescence, UV fluorescence photography, and reflectance photography.[2] UVFD has recently used the same UV light in a dermoscope and found promising results. Numerous epidermal and dermal substances emit fluorescence of different wavelengths on blue light exposures. Although the blue light penetrates only the superficial layers of the skin, it provides a better color contrast between melanin and blood. Endogenous substances like melanin, collagen, flavins, NADPH, and tryptophan, as well as exogenous substances (fungal or bacterial metabolites or even parasites), can also emit fluorescence.[2,4]

Melanin fluorescence and the role of Tyndall effect

Melanin can be detected with the aid of dermoscopy, and its color variations range from jet black dots to brown and steel blue nevus depending on the depth at which it is present from the skin surface. These variations can be explained by the Tyndall effect, which states that blue light with a shorter wavelength is dispersed and reflected more than red light with a longer wavelength. Another law governing the physics of dermoscopy is the principle of Rayleigh scattering. There is a scattering of light by the target chromophores, which are one-tenth the size of the wavelengths of light. This occurs without loss of energy or change in their wavelengths. UVFD detects superficial melanin as it is larger in size and more homogeneous in the superficial layers of skin, hence to help in the demarcation of the pigment.[3,5]

Role of photodiagnosis

Photodiagnosis has gained popularity in recent times and helps clinicians in differential diagnosis. The ultraviolet spectrum in the frequency range of 300-430 has found promising uses in dermatology. Furthermore, frequency ranges of 380-400 nm and 380-430 nm near-visible regions are absorbed by melanin and interpreted as purple light.[1,6] Porphyrins identified at 400 nm wavelengths in the soret band can also be detected by UVFD. A wavelength of 405 nm is necessary for vascular structures because it has high absorbances for both oxidized and nonoxidized hemoglobin and emits green fluorescence.[1] Besides this, fluorescence can also help in disease prognosis. Protoporphyrin IX is considered a key marker for disease severity in plaque psoriasis and acne vulgaris.[7] Togawa *et al*.,[6] in 2023, did a comparative study on 19 patients with pigmented skin lesions containing melanin utilizing P385 nm and P405 nm light under the same settings. P385 nm underexposure was found to be substantially lower than on P405 nm. Also, with P385 nm light, white lines, and lesional borders were clearly discernible.

Advantages of UVFD over Wood's lamp

- No need for a darkroom or to warm up the equipment beforehand.
- No obligation to hold the equipment at an appropriate distance from the skin.
- Less need for eye protection.
- External artifacts have less of an impact on imaging.
- More portable with the advantage of magnification.

There are a lot of lacunae in the literature that can help us understand this novel technique better. So, the current review aims to compare the features of ultraviolet fluorescence dermoscopy (UVFD) and polarized dermoscopy (PD) in various dermatological disorders.

Methods

This review was performed according to PRISMA (Preferred Reporting Items for Systematic Reviews and Metanalyses) guidelines. A comprehensive search of the literature was carried out through the PubMed and

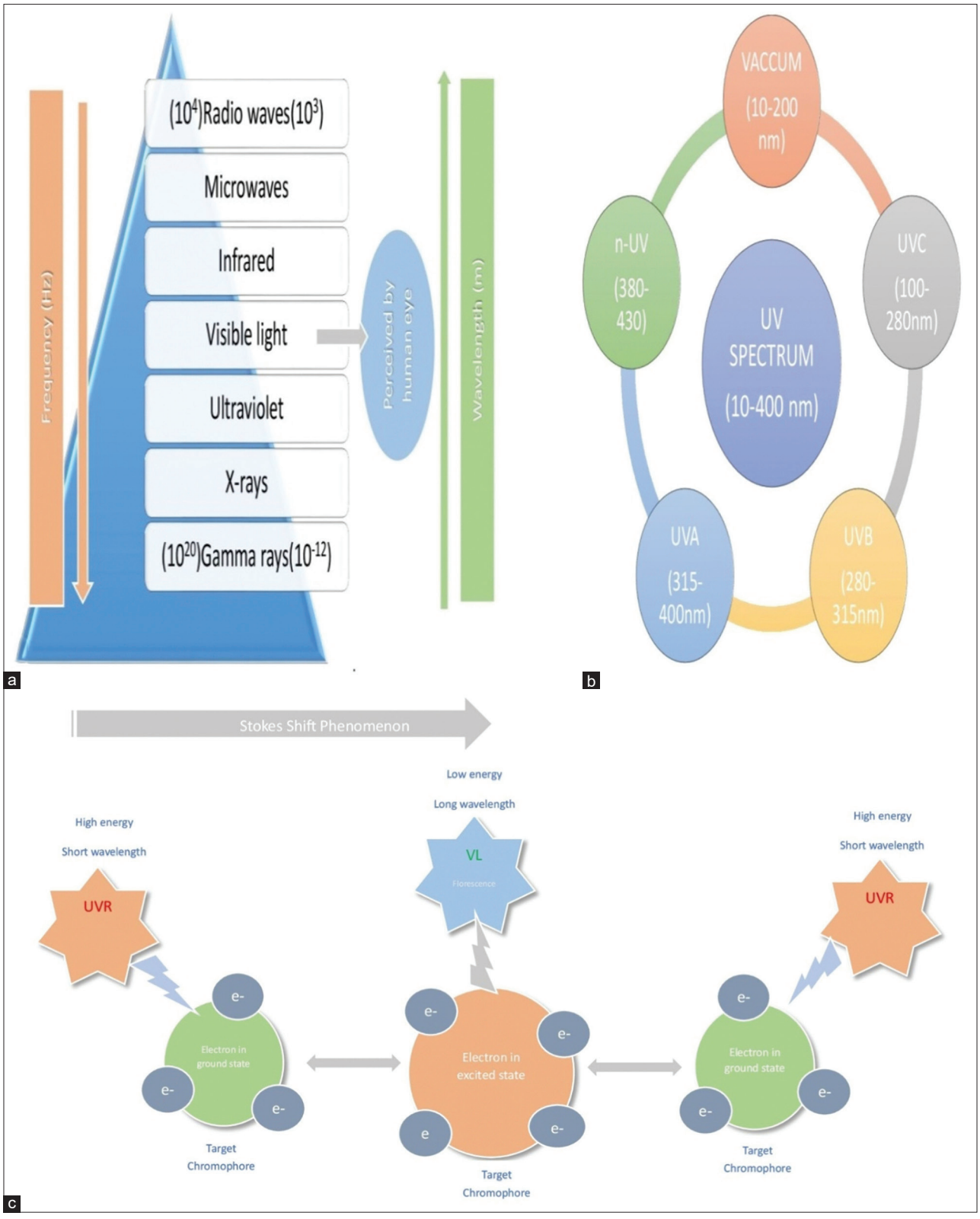


Figure 1: (a) Electromagnetic spectrum and (b) UV light spectrum. (c) Schematic diagram showing the emission of visible light (fluorescence) on UV light exposure of target chromophore and Stokes shift phenomenon

Google Scholar electronic databases from inception to 25th December 2023 using the following search terms: "UV dermoscopy" OR "ultraviolet fluorescence dermoscopy" OR "ultraviolet-induced fluorescence dermoscopy" OR "Ultraviolet-induced fluorescent dermoscopy". A manual search was also performed by analyzing the reference sections of all relevant studies or reviews on the topic. Titles, abstracts, and full texts were screened by two

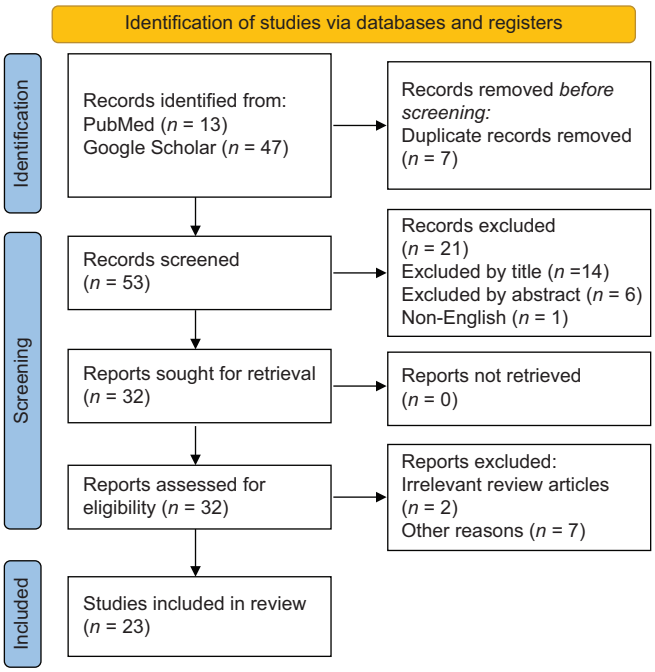
independent reviewers to select papers dealing with UVF-dermoscopy [Flow Diagram 1]. Inclusion criteria were (i) articles discussing ultraviolet dermoscopy, (ii) all types of articles excluding irrelevant review articles, and (iii) no sample size limitation. Exclusion criteria were (i) non-English articles, (ii) review articles, personal opinions/editorials and duplicates, and (iii) articles before the 2010 year of publishing. The results were further classified as per the Oxford Centre for Evidence-based Medicine (EBM) 2011 levels of evidence (LoE): Level 1 (systematic reviews of randomized control trials), level 2 (lesser quality RCT or prospective cohort study), level 3 (case-control study, nonrandomized controlled cohort or follow up study), level 4 (case series), and level 5 (expert opinion, mechanism-based reasoning).

Results

A total of 23 articles were included in this systematic review, including a total of 313 patients, of which pigmented skin tumors (209), Fordyce spot mimickers (13), scabies (57), biopsy site (20), psoriasis (3), corynebacterium infections (2), fungal infections (4), vitiligo (3), acne folliculitis (1) and glomus tumors (1). LoE was 3 and 4 in only two included studies; the rest had a LoE of 5. Table 1 compares the features of ultraviolet fluorescence dermoscopy (UVFD) and polarized dermoscopy (PD) in various dermatological disorders.

Pigmented skin tumors

A total of 209 patients with pigmented skin tumors, including malignant melanoma (MM), melanocytic nevus (MN), basal cell carcinoma (BCC), and seborrheic keratosis (SK), involving the face, trunk, and extremities were analysed. The results included that the most prevalent enhancement observed on UVFD was ulcers in MM and SK, followed by demarcation and vascular structures in MM and crusts and comedo-like openings in SK. The most common finding in MN was cribriform patterns and demarcations, and in BCC, these were milia-like cysts, ulcers, and crusts[1] [Figure 2a-c]. Demarcation was the second most commonly observed enhancement in MM and MN.[1] Also, delineation of melanin distribution in the lesion is more clearly apparent on UVFD than on PD.[8] Pale-colored lesions were readily discernible on UVFD and appeared as dark areas and could thus help in the determination of resection margins of melanoma over the heel.[9]



Flow diagram 1: PRISMA (Preferred Reporting Items for Systematic Reviews and Metanalyses)

Scabies

Recently, there has been a considerable increase in the cases of scabies worldwide. A total of 57 patients were included. The UVFD fluorescence was bright white around the scales, with a serpiginous outline representing a burrow.[11] Classic delta sign (formed by the mouth and front legs) can be identified. A few authors have also reported enhanced tunnel visualization utilizing n-UVFD[12] [Figure 2d-f]. The features observed included green dot, white dot, white wave, linear white fluorescence, Mite-Gallery Unit (MGU)-head part (Sarcoptes, green hue, green dot), between body and tail MGU (luminescent cloud), phlogosis halo around burrow (Rocket sign) and MGU's as segmental lines (Dragon sign).[13] Another study reported a complete strip (blue and white fluorescence) and a brown triangle in a patient with scabies.[14] Also, hatching eggs (bright blue fluorescence) and mites (dark fluorescence) have been reported.[15]

Biopsy site

A total of 20 patients were included in biopsy site identification prior to surgery. It was observed that the biopsy site appeared to be darker than the normal skin[16] [Figure 2g-i].

Psoriasis (plaque and nail)

UVFD has recently found its roots not only in diagnosis but also in the prognostic outcome of the disease. A total of 3 patients were included, and red fluorescence in psoriatic plaques was seen.[17] Bright blue-greenish (keratin), black hemorrhagic dot (hemoglobin), and pink-red (protoporphyrin IX) fluorescence have also been reported on the UVFD of a psoriatic plaque.[18] UVFD features of nail psoriasis included blurred fluorescence (normal nail areas) with distal yellowish ends (onycholysis) and bright illumination (crumbling)[19] [Figure 3a and b].

Corynebacterium infections

Trichomycosis axillaris (TA) is a superficial bacterial infection involving the soft keratin of the hair follicle, in particular axillary and, to a lesser extent, the pubic and scalp

Table 1: Comparison of features observed on PD Vs. UVFD in various dermatological diseases

Study author	Year	No. of patients (*n*)	Case included		PD	UVFD	Comments	LoE
Minagawa *et al.*[1]	2023	*n*=207	Pigmented skin tumors	MM	Demarcation 27	Ulcers: 2,100%	UVFD better delineates features confined to superficial layers of skin due to its nonpenetrance to deeper layers. Early detection and margins are free of tumors and have better surgical outcomes	3
					Blue-white structures 20	Demarcation: 26,96.3%		
					Pigment networks 12	Vascular Structures: 3,42.9%		
					Dots/globules 8	Milky red areas: 3,42.8%		
					Milky red areas 7	Blue-white Structures: 7,35.0%		
					Pseudonetworks 7	Dots/globules: 1,12.5%		
					Vascular structures 7	Scales: 1,14.3%		
					Scales 7	Pigment Networks: 1,8.3%		
					Ulcers 2	Pseudonetworks: 0,0%		
				MN	Demarcation 44	Cerebriform patterns 2,100%		
					Dots/globules 26	Demarcation 34,77.3%		
					Pigment networks 24	Vascular structures 1,14.3%		
					Blue-white structures 19	Blue-white structures 2,10.5%		
					Vascular structures 7	Pigment networks 1,4.2%		
					Streaks 4	Dots/globules 1,3.8%		
					Cerebriform patterns 2	Streaks 0,0%		
				BCC	Demarcation 75	Milia-like cysts 3,100%		
					Arborizing vessels 42	Ulcers 22,88.0%		
					Shiny white blotches and strands 41	Crusts 18,72.0%		
					Blue globules 32	Blue-white veils 5,55.6%		
					Blue-gray ovoid nests 27	MAY globules 2,40.0%		
					Crusts 25	Spoke wheel structures 2,40.0%		
					Ulcers 25	Vascular Structures 2,33.3%		
					Maple leaf-like structures 22	Arborizing vessels 8,19.0%		
					Dots/globules 19	Maple leaf-like structures 4,18.2%		
					Blue-white veils 9	Demarcation 13,17.3%		
					Scales 6	Shiny white blotches and strands 7,17.1%		
					Vascular structures 6	Scales 1,16.7%		
					MAY globules 5	Dots/globules 0,0%		
					Spoke wheel structures 5	Blue globules 0,0%		
					Milia-like cysts 3	Blue-gray ovoid nests 0,0%		
					Streaks 2	Streaks 0,0%		

Contd...

Table 1: Contd...

Study author	Year	No. of patients (*n*)	Case included		PD	UVFD	Comments	LoE
				SK	Demarcation 61	Ulcers 2,100%		
					Comedo-like openings 32	Crusts 6,100%		
					Cerebriform patterns 28	Comedo-like openings 25,78.1%		
					Milia-like cysts 20	Cerebriform patterns 20,71.4%		
					Fingerprint-like structures 13	Vascular structure (Dots vessels) 2,66.7%		
					Hairpin vessels with halo 12	Fingerprint-like structures 4,30.8%		
					Pseudo-networks 8	Demarcation 16,26.2%		
					Scales 6	Milia-like cysts 5,25.0%		
					Crusts 6	Hairpin vessels with halo 1,8.3%		
					Erythema 4	Scales 1,16.7%		
					Vascular structure (Dots vessels) 3	Pseudonetworks 0,0%		
					Ulcers 2	Erythema 0,0%		
Sano *et al.*[8]	2021	*n*=1		MM	The demarcation of melanin distribution in the lesion is more clearly visualized on UVFD			5
Shu *et al.*[9]	2022	*n*=1			Pale-colored lesions are easily appreciated and present as dark areas in the grey scale images on UVFD			5
Pietkiewicz *et al.*[3]	2023	*n*=12/14	Fordyce spot mimickers	FS	Well demarcated (Superficial)	bright blue/green, blue/red, yellow, orange or red fluorescent dots (Sebaceous gland duct openings)	UVFD helped in differentiating Fordyce spot mimickers Better diagnostic and prognostic outcome	4
					Poor demarcated (Deep)			
					Clustered, roundish white-yellowish clods.			
					Central, slightly brighter dots (Opening of sebaceous glands)	UVRD-neutral clods (Sebaceous glands)		
				LP	White lines	White lines are not appreciable		
					Erythematous areas	Erythematous areas appear larger and darker		
				MC	Central yellow-white clod/grouped clods	Papules appear dark with no white circles		
					Single or clustered skin-colored clods	Faded yellowish fluorescence of pores		
					Linear vessels (Radial arrangement)			
					Sparing of the central aspect of the lesion			
					Whitish central pore/pores with a surrounding white circle (Visible umbilication)			
				PPP	Whitish clods	No fluorescence		
					Glomerular vessels			
				VW	Dotted vessels	No or dark fluorescence		
					Glomerular vessels	Perivascular bright halos		
					White lines	Fluorescence (Tips of the elongated papillae)		

Contd...

Table 1: Contd...

Study author	Year	No. of patients (*n*)	Case included	PD	UVFD	Comments	LoE
				Tan or pink structureless area. Skin-colored elongated clods, some with Centered linear looped vessels Scales	Mild-intensity reddish/coral luminescence		
			GP	Perifollicular and noninterrupted annular keratotic rim (Cornoid lamella) Affected area (Skin colored)	Rim of scale and central perifollicular hyperkeratosis (Enhanced bright fluorescence) Affected area (Brighter than normal skin)		
Chi *et al*.[10]	2017	*n*=1	Porokeratosis	White track sign Brown globules or dots Central scar-like structures Enlarged capillary vessels	Shiny diamond necklace sign (Green fluorescence)	Better diagnostic outcome	5
Tang *et al*.[11]	2019	*n*=1	Scabies	Whitish scales Burrow Mite Eggs	Bright white fluorescence	Better diagnostic outcome	5
Aslan Yürekli *et al*.[12]	2023	*n*=1		Better visualization of the tunnel and Ball sign on UVFD			5
Scanni *et al*.[13]	2022	*n*=53		Typical MGU Delta sign Pink vascular infiltrate Brownish triangle (*Sarcoptes* mite) Fecal pellets Erosions Fuzzy tails Purplish area (Hematoma)	Green dot White dot White wave Linear white fluorescence Mite-Gallery Unit Head part (*Sarcoptes*, green hue, green dot) Between body and tail MGU (Luminescent cloud) Phlogosis halo Rocket sign Dragon sign		3
Nie *et al*.[14]	2021	*n*=1		Brown balls or dots	Complete strip (Blue and white fluorescence) Brown triangle		5
Zhang *et al*.[15]	2022	*n*=1		Sinuous burrow Triangular brown jet	Hatching Egg (Bright blue fluorescence) Mite (Dark fluorescence)		5
Navarrete-Dechent *et al*.[16]	2023	*n*=20	Biopsy site	The biopsy site appears to be darker (72%)	The biopsy site appears to be darker (93%)	Better diagnostic & prognostic outcome	4

Contd...

Table 1: Contd...

Study author	Year	No. of patients (*n*)	Case included	PD	UVFD	Comments	LoE
Xie *et al.*[17]	2022	*n*=1	Psoriasis (Plaque & Nail)	Thick silver-white scales Glomerular vessels	Brick-red fluorescence Silver-white scales Glomerular vessels Auspitz sign Bright blue background	Better diagnostic, prognostic & therapeutic outcome	5
Pietkiewicz *et al.*[18]	2023	*n*=1		Silvery white-yellowish scale Single hemorrhagic dots	Bright blue-greenish fluorescence (Keratin) Black hemorrhagic dot (Hemoglobin) Pink-red fluorescence (Protoporphyrin IX)		5
Gao *et al.*[19]	2021	*n*=1		Dry and split proximal nail fold Rough surface Schizonychia Onycholysis without luster	Blurred fluorescence (Normal areas) Distal yellowish ends (Onycholysis) Bright illumination (Crumbling)		5
Al-Nasiri *et al.*[20]	2023	*n*=1	*Corynebacterium* TA Infections	Yellowish-whitish bacterial conglomerates wrapping the hair	Bright yellow-green fluorescence	Better diagnostic & therapeutic outcome	5
Pietkiewicz *et al.*[21]	2023	*n*=1	PK	Small pits with a free edge Peripheral scale irregular scaling	Excited fluorescence coral-red eccrine dots and peri eccrine clods (Crateriform pits) Pale coral-red pits with a free edge of the scale Pale coral-red parallel ridge patterns Pale coral-red clods in the ridges		5
Tang *et al.*[22]	2017	*n*=1	Fungal Infections	Accumulated scales and black dots Bar code-like hairs	Bright-white fluorescence (Accumulated scales) Bright-green fluorescence (Hair shafts)	Better diagnostic & therapeutic outcome	5
Tang *et al.*[23]	2019	*n*=1		Yellowish scales Follicular micro pustules Vellus hair with white sheath	Green fluorescence		5
Liu *et al.*[24]	2020	*n*=1		Single curly and coily hair	Three curly and coily hairs with bright-white fluorescence	Combo dermoscopy yields better results	5
Łabędź *et al.*[25]	2023	*n*=?	Fungal Infections (Pityriasis versicolor)	Typical furrow scaling Follicular hyperpigmented (Small, roundish, folliculocentric reddish-tan or tan areas with discrete to no scaling) Perifollicular furrow Peripheral inward scaling Contrast halo sign	Fungal chromophore pityrialactone (Light greenish excited fluorescence) Single- or double-edged furrow scale and perifollicular scaling Light greenish Perifollicular scale Blackout areas	Better diagnostic outcome	5

Contd...

Table 1: Contd...

Study author	Year	No. of patients (*n*)	Case included	PD	UVFD	Comments	LoE
					Folliculocentric hyperpigmented (Dark greenish fluorescence) Subtle peripheral free edge of scale is seen better Contrast halo sign (Dark curvilinear border)		
Yuan *et al.*[26]	2023	*n*=3	Vitiligo	Perifollicular pigmentation and blurred borders Sharply demarcated borders and perifollicular depigmentation. Reservoir of pigmentation and telangiectasia	Progressive lesions show enhancement of perifollicular pigmentation and blurred borders Stable lesions show better visualization of sharply demarcated borders and perifollicular depigmentation Regimentation lesions show enhancement of the reservoir of pigmentation and telangiectasia	Better quality diagnostic images were obtained on UVFD	5
Singh *et al.*[27]	2019	*n*=1	Acne & folliculitis	Follicular plugs	Bright pink fluorescence (*Cutibacterium acne* metabolites) Light blue fluorescence (*Malassezia* yeasts) Light-blue fluorescence (Vellus hair) under high resolution	Evaluating the microbes and parasites without interference with normal skin microbiota	5
Thatte *et al.*[28]	2015	*n*=1	Glomus tumor	Altered pigmentary network	Pink glow	Better diagnostic outcome	5

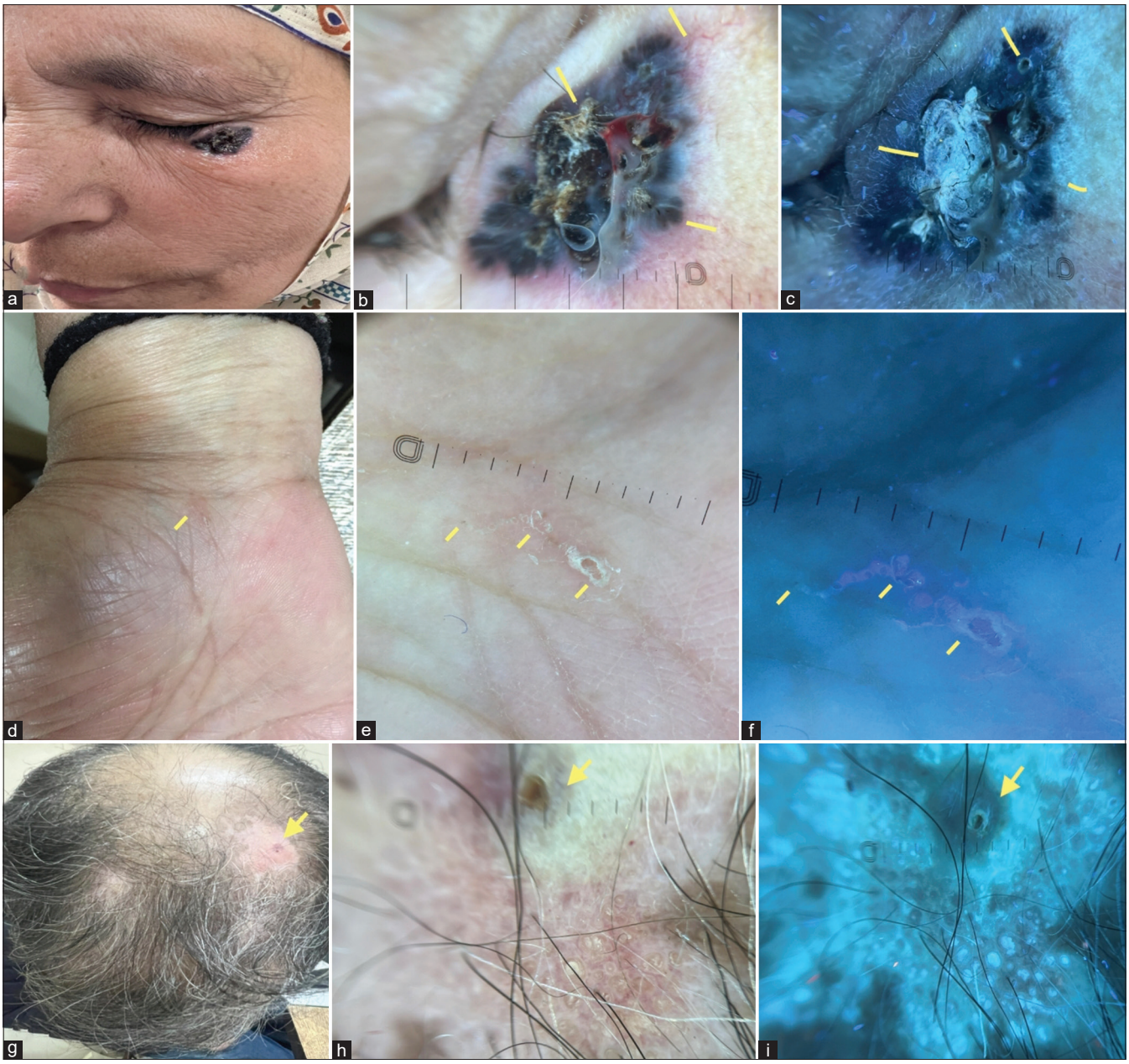


Figure 2: (a) Clinical image of basal cell carcinoma over the left infraorbital region, (b) Dermoscopic images showing bluish ovoid globules, leaf-like areas, central crusting and arborising vessels (DL5, polarized, 10×), and (c) Crusts, ulceration and milia like cysts (DL5, UVF mode, 10x); (d) Clinical image of scabies, (e) Dermoscopic images showing burrow, triangle sign depicting the head and jet in contrail sign of body and tail end (DL5, polarized, 10×) and (f) More prominent bright whitish fluorescence of the body and tail end (ball sign) and better visualization of the tunnel (DL5, UVF mode, 10×); (g) Clinical image of biopsy site demarcation in a patient of discoid lupus erythematosus, (h) Dermoscopic images showing brownish clod with homogeneous white areas (DL5, polarized, 10×), and (i) Darker area than the surroundings with central crust (DL5, UVF mode, 10×)

hair. Most of the infections are caused by corynebacterium species. A total of 2 patients were included, and bright yellow-green fluorescence was observed.[20] Red angulated lines and polygonal or structureless area appearances of scales have been reported[4] [Figure 3c-e]. Pitted keratolysis (PK) is another corynebacterial infection clinically presenting as multiple planter pits secondary to desmosomal alterations in stratum corneum due to bacterial proteases. UVFD features include excited fluorescence coral-red eccrine dots and peri eccrine clods, which correspond to crateriform pits. Also, pale coral-red pits with a free edge of the scale, pale coral-red parallel ridge patterns, and pale coral-red clods in the ridges have been reported.[21] Of note, red fluorescence may sometimes be lacking, especially after washing the skin (authors' personal observations) [Figure 3f-h].

Fungal infections

Tinea capitis and vellus dermatophytosis are other dermatoses that can be diagnosed with UVFD aid.

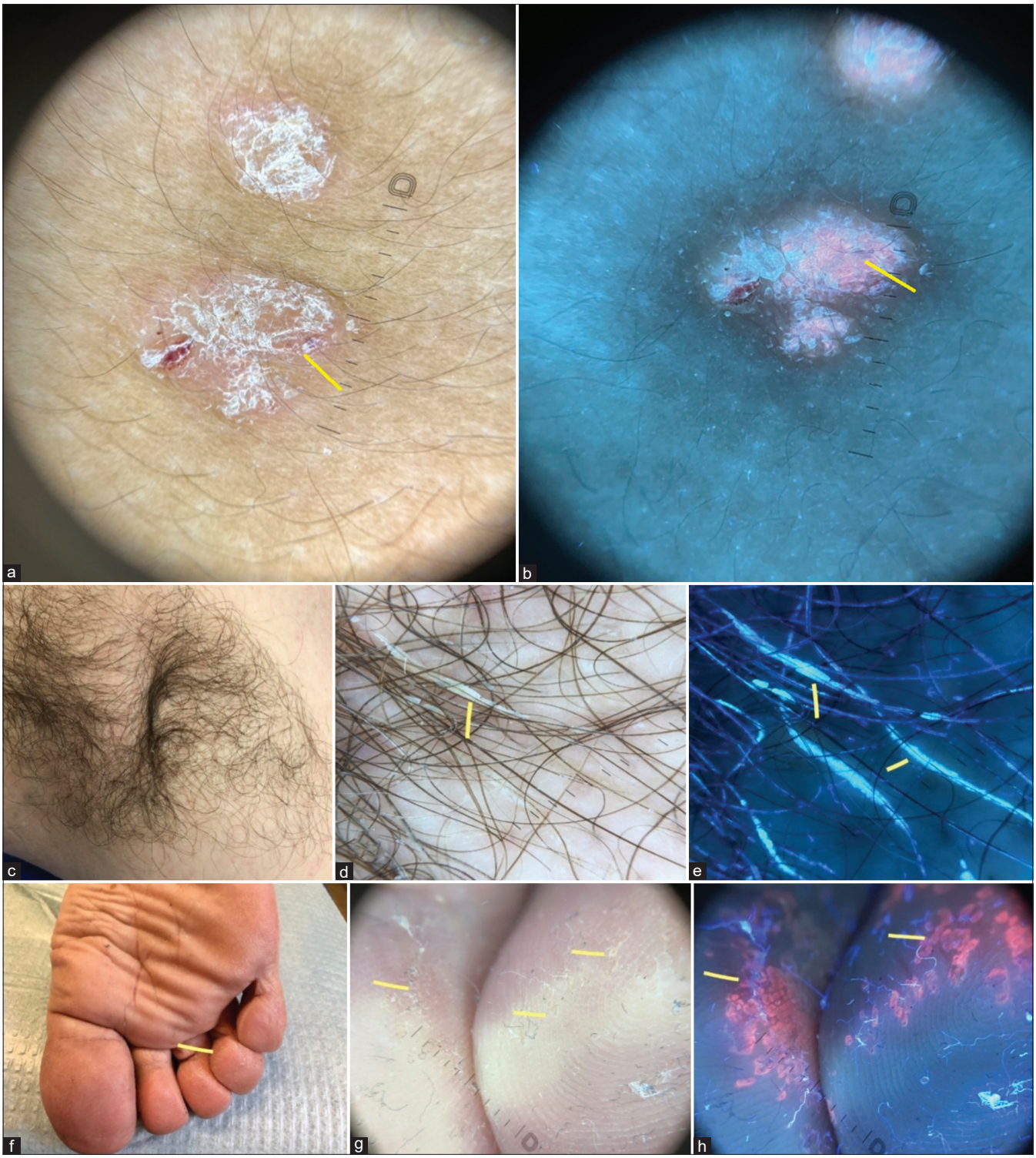


Figure 3: (a) Dermoscopic images of psoriasis showing whitish scales with the regular red dots on background erythema (DL5, polarized, 10×) and (b) Red fluorescence and bright white scales (DL5, UVF mode, 10×); (c) Clinical image of trichomycosis, (d) Dermoscopic images showing yellowish white bacterial conglomerate wrapping the hair (DL5, polarized, 10×), and (e) Bright yellow-greenish fluorescence (DL5, UVF mode, 10×); (f) Clinical image of pitted keratolysis, (g) Dermoscopic images showing pits with peripheral irregular scale (DL5, polarized, 10×) and (h) Coral red fluorescent clods in the ridges (DL5, UVF mode, 10×)

A total of four patients were included, and bright-white fluorescence (accumulated scales), bright-green fluorescence (hair shafts), and bright-white fluorescence disappearance at the white bands of the barcode-like hairs were also observed.[22] UVFD findings in vellus dermatophytes observed green fluorescence at the proximal hair shafts.[23] Three curly and coily hairs with bright-white fluorescence indicating vellus tinea have also been

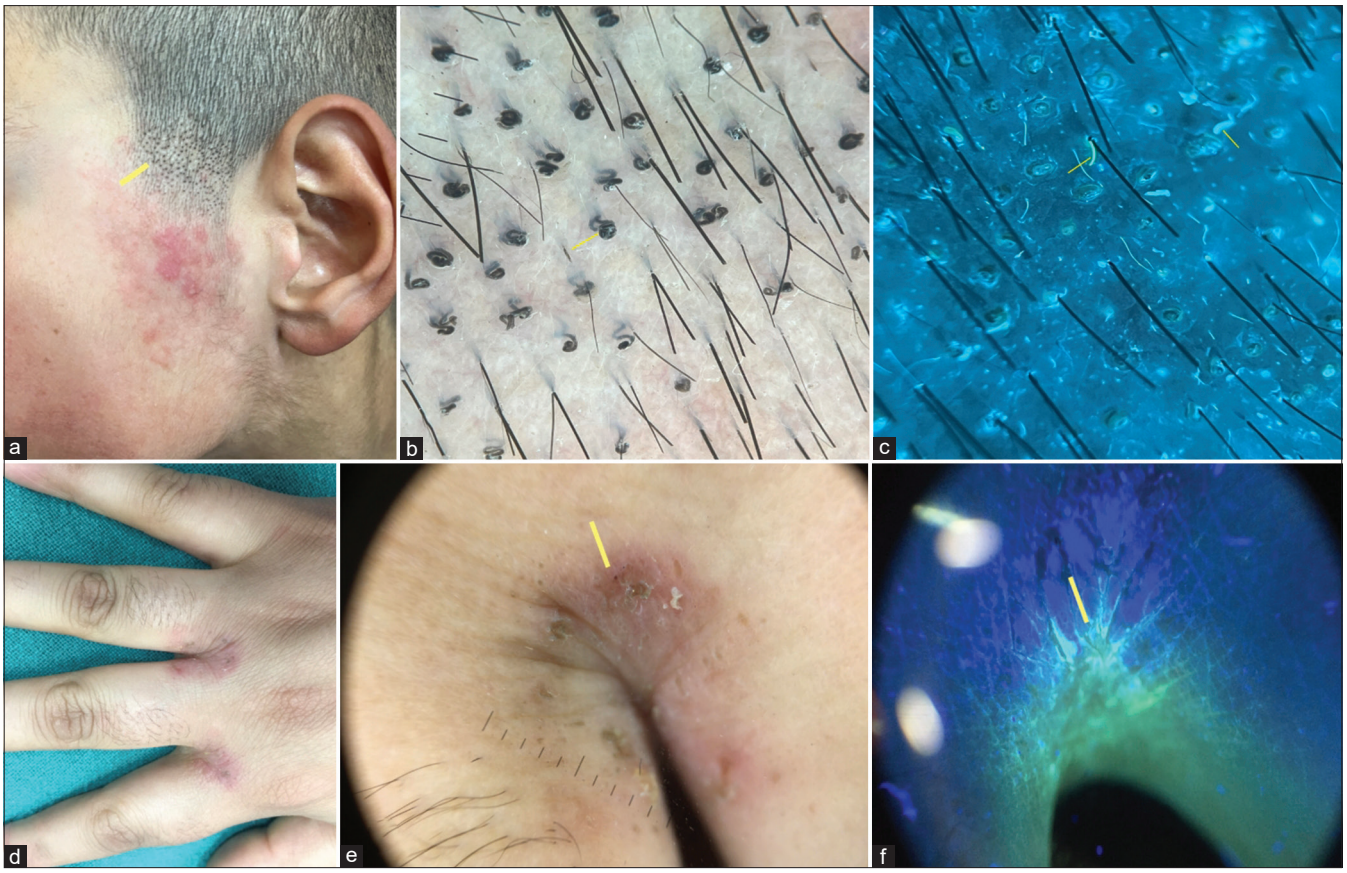


Figure 4: (a) Clinical image of tinea capitis, (b) Dermoscopic images showing corkscrew-like hairs (DL5, polarized, 10×) and (c) Bright green fluorescence of vellus hair shafts and bright white fluorescence of scales (DL5, UVF mode, 10×); (d) Clinical image of Intertrigo in a diabetic patient, (e) Dermoscopic images showing crusts, scales, erythema (DL5, polarized, 10×), and (f) Greenish fluorescence in the web due to *Pseudomonas aeuroginosa* (DL5, UVF mode, 10×)

reported[24] [Figure 4a-c]. Pityriasis versicolor is another dermatophyte infection caused by *Malassezia* species, more commonly by globosa>furfur. The observations included fungal chromophore pityrialactone (light greenish excited fluorescence), single- or double-edged furrow scale, and light greenish perifollicular scale. Also, folliculocentric hyperpigmented areas (dark greenish fluorescence) and subtle peripheral free edges of scale were seen better, and a contrast halo sign (dark curvilinear border) was observed.[25]

Intertrigo

Intertrigo is a common inflammatory dermatosis secondary to chronic irritation, high temperatures, and sweating. Secondarily infected commonly by candida but can also have other bacterial and viral etiologies. No study could be found on this dermatosis, so all findings are the author's own observations. Green fluorescence in *Pseudomonas* (*pyoverdin*), red fluorescence in foot intertrigo (*coproporphyrin III*), and greenish in *Microsporum* species (*pteridine*). Inverse psoriasis, which shows a red fluorescence *(protoporphyrin IX*), can be differentiated from flexural intertrigo with UVFD aid[4] [Figure 4d-f].

Vitiligo

Skin devoid of melanin fluoresces brightly. Yuan *et al*.[26] reported a unique use of UVFD in diagnosing vitiligo (progressive, stable, and regimenting). A total of three patients were included, and it was observed that UVFD led to the enhancement of perifollicular pigmentation and blurred borders in progressive lesions. Stable lesions revealed better visualization of sharply demarcated borders and perifollicular depigmentation. Regimentation lesions revealed enhancement of the reservoir of pigmentation and telangiectasia [Figure 5a-i].

Acne and folliculitis

Only one patient was included in this, and a bright pink fluorescence was found, likely due to coproporphyrin III/ protoporphyrin IX (*Cutibacterium acne* metabolites) and light blue fluorescence (*Malassezia* yeasts). Light-blue fluorescence (vellus hair) was observed under high resolution and was related to keratin as follicular keratosis. Some areas don't have fluorescence and are termed follicular blackout areas. Demodex-induced rosacea is a granulomatous disease with a high prevalence. Live *Demodex folliculorum* mites (1 mm size) could be easily traced as continuously crawling structures (bright white fluorescence)[27] [Figure 5j-l].

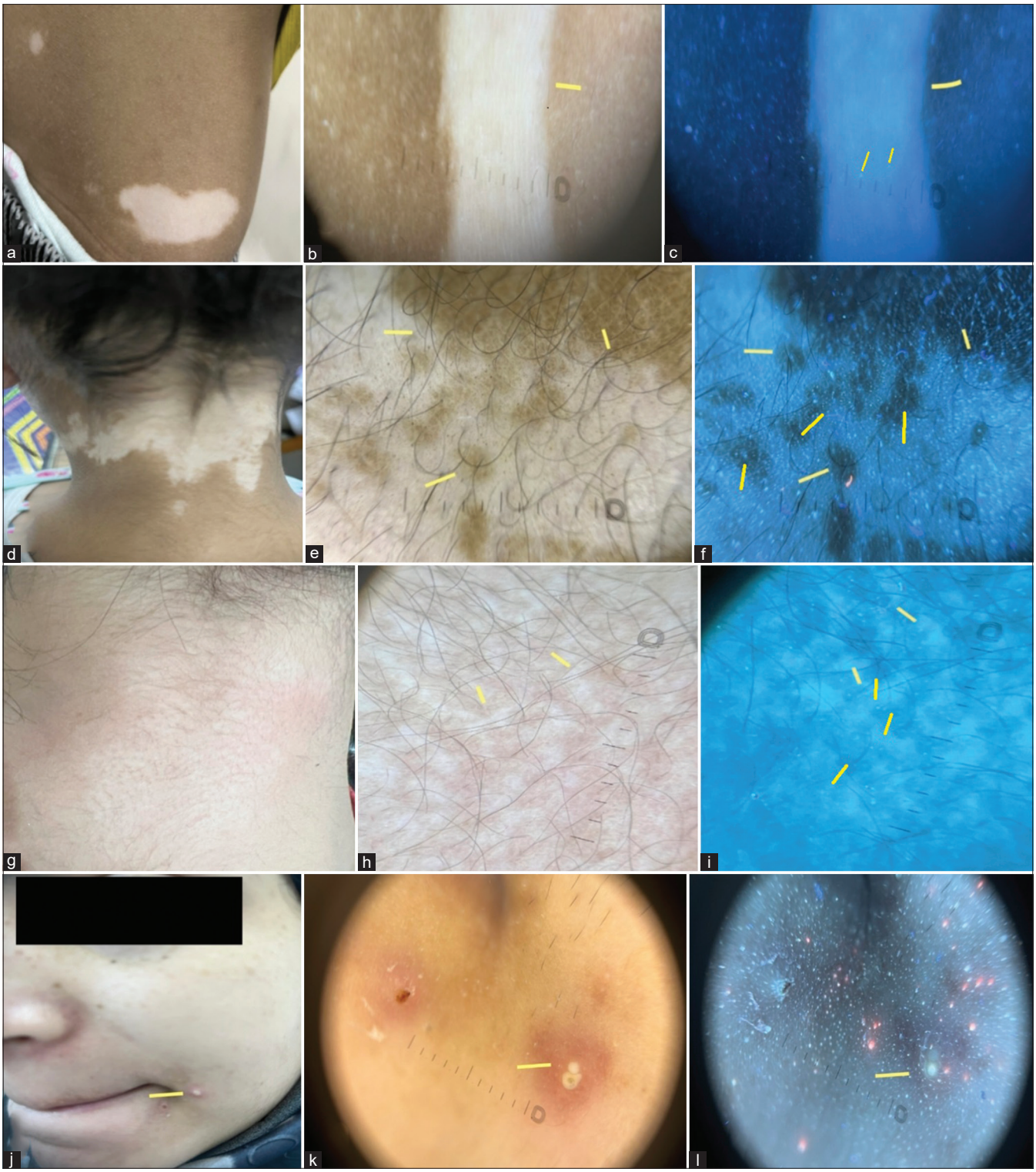


Figure 5: (a) Clinical image of stable vitiligo, (b) Dermoscopic images showing well-defined borders and uniform white glow (DL5, polarized, 10×) and (c) Bright fluorescence, sharply demarcated borders and perifollicular depigmentation (DL5, UVF mode, 10×); (d) Clinical image of progressive vitiligo, (e) Dermoscopic images showing interfollicular depigmentation, perifollicular pigmentation and burred borders (DL5, polarized, 10×) and (f) Enhancement of perifollicular pigmentation and blurred borders (DL5, UVF mode, 10×). (g) Clinical image of repigmenting vitiligo, (h) Dermoscopic images showing perifollicular repigmentation (DL5, polarized, 10×) and (i) More apparent perifollicular repigmentation with interfollicular depigmentation existing (DL5, UVF mode, 10×); (j) Clinical image of inflammatory acne, (k) Dermoscopic images showing yellowish clods with surrounding erythema (DL5, polarized, 10×) and (l) Bright pink fluorescence localized to pilosebaceous units by *Cutibacterium acnes* and follicular blackout areas in the area of inflammatory acne lesions (DL5, UVF mode, 10×)

Others: Fordyce spot, viral infections, lichen planus, porokeratosis, glomus tumor, and pearly penile papules

A total of 13 patients were included. Observed enhancements included bright blue or green, blue or red, yellow-orange or red fluorescent dots (sebaceous duct openings), and neutral clods (sebaceous glands) in FS; white lines were not appreciable, and erythematous areas appeared larger and darker in lichen planus (LP); papules appeared darker with no white circles and faded yellowish fluorescence of pores in molluscum contagiosum (MC); no fluorescence in pearly penile papules (PPP); no or dark fluorescence, perivascular bright halos fluorescence (tip of elongated papillae), mild intensity reddish or coral fluorescence in viral warts (VW); and lastly, genital porokeratosis (GP) showed rim of scale and central hyperkeratosis (enhanced bright fluorescence) and affected areas appeared brighter than normal areas.[3] Porokeratosis also showed a unique shiny diamond necklace sign (green fluorescence) on UVFD.[10] Bright pink glow on UVFD in a patient with glomus tumor.[28]

Discussion

UVF dermoscopy is a novel tool that has found its roots as a diagnostic and prognostic asset in neoplastic and non-neoplastic dermatological disorders. This is the first systematic review of its kind, categorizing and comparing the polarized and UVF dermoscopic findings in dermatological practice. We found that in neoplastic disorders, superficial structures are better delineated on UVF dermoscopy than on polarized dermoscopy. Minagawa *et al*.,[1] in 2023, hypothesized these findings due to the UVFD's capacity to detect superficial melanin, which is larger in size and more homogeneous in the superficial layers of skin. The explanations for the enhancement of the least documented features were believed to be attributed to ultraviolet (UV) radiation failing to penetrate deeper layers of the skin. Another study concluded a prognostic value of UVFD by its ability to appreciate even subtle pigmentation and could aid in determining margin-free lesions, which was proved with histopathology.[9] Ulcers are believed to be significant prognostic markers for MM, which can be better seen on UVFD.[1] We recommended using UVFD in collab with PD for better diagnostic and prognostic outcomes.

Tang *et al*.[11] used a PD and UVFD combo approach to examine a scabies patient. They concluded that combining approaches yielded a superior diagnostic outcome. Later, Aslan Yürekli *et al*.[12] in 2023 observed that depending on the depth at which the parasite is present in the skin, it can sometimes not be appreciated if it is deep into the skin, leading to a diagnostic dilemma. As a result, a novel feature referred to as a *ball sign* was identified utilizing the innovative n-UVFD. A bright white fluoresce structure and the whole mite could be better seen, giving a more diagnostic yield. They hypothesized that on n-UVFD, the contents of the tunnel and mite elicited bright reflectance in contrast to other nonreflective skin appendages. This entire parasite, which resembles a ball, can be seen on n-UVFD.[13]

Navarrete-Dechent *et al*.,[16] in 2023, did a retrospective study, and it was observed that the biopsy site appeared to be darker, which was postulated to be due to inflammation and hypervascularity. Xie *et al*.[17] were the first to observe psoriatic plaque fluorescence, and this was likely due to epidermal porphyrins (protoporphyrin IX). A bright red fluorescence, secondary to protoporphyrin IX, can be seen in the peripapillary areas around the tortuous vessels. It was postulated that protoporphyrin IX mainly accumulated in advanced psoriatic lesions, thus correlating with disease severity.[18]

Al-Nasiri *et al*. reported unique UVFD features of corynebacterial infections. They postulated it to be likely due to an admixture of sweat and bacterial products and secondary to coproporphyrin III in trichomycosis axillaris and erythrasma, respectively.[20] Different fluorescences have been observed, depending on the underlying causative agents in intertrigo. This can help differentiate one from another, thus having diagnostic implications.[4] Tang *et al*.[22] first reported the UVFD findings in fungal infection. They postulated it secondary to chemical pteridine produced by some *Microsporum* species, which helped differentiate fungal infections with different aetiologies due to positive or negative fluorescence.[23]

Łabędź *et al*.[25] reported UVFD features in patients with pityriasis versicolor. Blackout areas were observed secondary to the release of azelaic acid by *Malassezia* yeast that inhibits *Cutibacterium acnes*. Depigmenting disorders like vitiligo showed better margin differentiation and differentiation between various types of vitiligo, which have implications in terms of treatment planning and prediction of disease activity.[26] Singh *et al*.[27] reported that UVFD features in inflammatory acne show less fluorescence due to the inability of *cutibacterium acne* to colonize because of its anaerobic nature and high oxygen tension, which they termed blackout areas. Also, *demodicosis* mites could be easily traced, which was postulated that UVFD could help evaluate the microbes and parasites without interfering with normal skin microbiota. Pietkiewicz *et al*.,[3] in 2023, did a retrospective study on Fordyce spot mimickers, which could also be differentiated by specific fluorescence.

Limitations

- There are studies with lower levels of evidence (LoE).
- Maximum number of studies have small sample sizes.
- There are no control groups.

Conclusion

UVFD is a novel diagnostic modality that is becoming more common in current dermatological practices. It is a fast, easy-to-apply, low-cost modality, increasing diagnostic confidence in infectious and noninfectious dermatosis. This systematic review included 23 clinical studies, meeting our primary objective on various dermatoses. We concluded that UVFD will improve clinical diagnosis, disease management, and outcomes. More clinical trials with larger sample sizes are recommended better to understand this novel and intriguing new diagnostic tool.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Minagawa A, Meling MT, Koga H, Okuyama R. Near-ultraviolet light dermoscopy for identification of pigmented skin tumours. Acta Derm Venereol 2023;103:adv00876.
2. Mojeski JA, Almashali M, Jowdy P, Fitzgerald ME, Brady KL, Zeitouni NC, *et al*. Ultraviolet imaging in dermatology. Photodiagnosis Photodyn Ther 2020;30:101743.
3. Pietkiewicz P, Navarrete-Dechent C, Goldust M, Korecka K, Todorovska V, Errichetti E. Differentiating fordyce spots from their common simulators using ultraviolet-induced fluorescence dermatoscopy-retrospective study. Diagnostics (Basel) 2023;13:985.
4. Dyer JM, Foy VM. Revealing the unseen: A review of wood's lamp in dermatology. J Clin Aesthet Dermatol 2022;15:25-30.
5. Sonthalia S, Yumeen S, Kaliyadan F. Dermoscopy overview and extradiagnostic applications. In: StatPearls. Treasure Island, FL: StatPearls Publishing; 2023.
6. Togawa Y, Yamamoto Y, Matsue H. Clinical study on the comparison of dermoscopic images using two wavelengths of near-ultraviolet-visible light. JEADV Clinical Practice 2024;3:214-8.
7. Wang B, Xu YT, Zhang L, Zheng J, Sroka R, Wang HW, *et al*. Protoporphyrin IX fluorescence as potential indicator of psoriasis severity and progression. Photodiagnosis Photodyn Ther 2017;19:304-7.
8. Sano T, Minagawa A, Suzuki R, Koga H, Okuyama R. Dermoscopy with near-ultraviolet light highlights the demarcation of melanin distribution in cutaneous melanoma. J Am Acad Dermatol 2021;84:e23-4.
9. Shu J, Yamamoto Y, Aoyama K, Togawa Y, Kishimoto T, Matsue H. Assessment of malignant melanoma lesions using violet-light dermoscopy: A case report. J Dermatol 2022;49:710-3.
10. Chi C, Liu J. Image Gallery: Porokeratosis under the dermoscopic furrow ink test and ultraviolet light. Br J Dermatol 2017;177:e159.
11. Tang J, You Z, Ran Y. Simple methods to enhance the diagnosis of scabies. J Am Acad Dermatol 2019;80:e99-100.
12. Yürekli A, Muslu İ, Pektaş SD, Alataş ET, Aydoğdu CT, Daşgin D. Using ultraviolet dermoscopy in diagnosing scabies. Exp Dermatol 2023;32:1996-9.
13. Scanni G. Facilitations in the clinical diagnosis of human scabies through the use of ultraviolet light (UV-Scab Scanning): A case-series study. Trop Med Infect Dis 2022;7:422.
14. Nie J, Gou T, Xu L, Wang W, Zhang L, Lu Y. Misdiagnosed scabies correctly diagnosed by dermoscopy using ultraviolet light mode. Clin Exp Dermatol 2021;46:1601-3.
15. Zhang LW, Wang WJ, Liu XY, Xu L, Zheng L, Li CH, *et al*. Scabies evaluated by dermoscopy and fluorescence microscopy: A case report. Int J Dermatol Venereol 2021;4:260-2.
16. Navarrete-Dechent C, Pietkiewicz P, Dusza SW, Andreani S, Nehal KS, Rossi AM, *et al*. Ultraviolet-induced fluorescent dermoscopy for biopsy site identification prior to dermatologic surgery: A retrospective study. J Am Acad Dermatol 2023;89:841-3.
17. Xie Y, Zheng Y, Yuan M, Zhang Z, Yang C, Li J. Specific features of psoriasis vulgaris under the ultraviolet dermoscopy. Photodiagnosis Photodyn Ther 2022;40:103100.
18. Pietkiewicz P, Navarrete-Dechent C, Mayisoğlu H, Jolly G, Kutlu Ö, Errichetti E. Pink-red fluorescence observed in ultraviolet-induced fluorescence dermoscopy of psoriatic plaques. Dermatol Pract Concept 2023;13:e2023243.
19. Gao RY, Pradhan S, Ran YP. Nail psoriasis in a child observed under ultraviolet dermoscopy treated by a topical biological agent cream: A case report. Int J Dermatol Venereol 2021;4:251-3.
20. Al-Nasiri M, Navarrete-Dechent C, Korecka K, Salwowska N, Goldust M, Pietkiewicz P. Ultraviolet-induced fluorescence dermatoscopy of trichobacteriosis axillaris reveals peripilar yellow-green luminescent concretions. Dermatol Pract Concept 2023;13:e2023169.
21. Pietkiewicz P, Navarrete-Dechent C, Salwowska N, Cantisani C, Goldust M, Errichetti E. Ultraviolet-induced fluorescence dermatoscopy reveals fluorescent clues in pitted keratolysis. Dermatol Pract Concept 2023;13:e2023242.
22. Tang J, Ran X, Ran Y. Ultraviolet dermoscopy for the diagnosis of tinea capitis. J Am Acad Dermatol 2017;76:S28-30.
23. Tang J, Ran Y. Polarized and ultraviolet dermoscopy for the diagnosis of dermatophytosis of vellus hair. Indian J Dermatol Venereol Leprol 2020;86:607.
24. Liu ZH, Zhi HL, Xia XJ. Combination dermoscopy highlights fungal invasion of vellus hair in tinea vellus. Clin Exp Dermatol 2022;47:138-9.
25. Łabędź N, Navarrete-Dechent C, Kubisiak-Rzepczyk H, Bowszyc-Dmochowska M, Pogorzelska-Antkowiak A, Pietkiewicz P. Pityriasis versicolor-A narrative review on the diagnosis and management. Life (Basel) 2023;13:2097.
26. Yuan M, Xie Y, Zheng Y, Zhang Z, Yang C, Li J. Novel ultraviolet-dermoscopy: Early diagnosis and activity evaluation of vitiligo. Skin Res Technol 2023;29:e13249.
27. Singh N, Yang H, Pradhan S, Ran X, Ran Y. Image gallery: Wandering Demodex mite *in vivo* under ultraviolet dermoscopy of rosacea. Br J Dermatol 2020;182:e2.
28. Thatte SS, Chikhalkar SB, Khopkar US. "Pink glow": A new sign for the diagnosis of glomus tumor on ultraviolet light dermoscopy. Indian Dermatol Online J 2015;6:S21-3.