

Differences Between Polarized Light Dermoscopy and Immersion Contact Dermoscopy for the Evaluation of Skin Lesions

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Objective: To evaluate dermoscopic features and patterns of skin lesions by using conventional and polarized light dermoscopy (PD).

Design: Observational study.

Setting: Dermatology clinic at Memorial Sloan-Kettering Cancer Center.

Patients: Ninety patients with skin lesions.

Interventions: Skin lesions were imaged via conventional nonpolarized light contact dermoscopy (NPD), polarized light contact dermoscopy (PCD), and polarized light noncontact dermoscopy (PNCD).

Main Outcome Measures: The images from the 3 modalities were evaluated by 3 dermoscopists for colors, structures, and patterns. Level of agreement between modalities was assessed by percentage agreement and the κ statistic. Qualitative differences between modalities were also assessed.

Results: Ninety lesions comprising 55 melanocytic and 35 nonmelanocytic lesions were reviewed. There was ex-

cellent agreement for overall dermoscopic patterns between modalities, with κ values ranging from 0.88 to 1.00. There was moderate to excellent agreement for most dermoscopic colors, with the exception of blue-white veil and pink (red) color. Most dermoscopic structures had fair to perfect agreement, with the exception of milium-like cysts. Qualitative assessment suggested that melanin appeared darker and blue nevi had more shades of blue on PD compared with NPD images; vessels and red areas were better visualized with PD, suggesting that PD may be helpful in identifying malignancies; milium-like cysts and comedolike openings were better visualized with NPD, suggesting that NPD is more helpful for identification of seborrheic keratosis; peppering, lighter colors, and blue-white areas were more evident under NPD, facilitating recognition of regression areas; and shiny-white streaks, possibly representing fibrosis, were seen more clearly under PD.

Conclusions: The capabilities of NPD, PCD, and PNCD are not equivalent, but complementary. Further studies are needed to evaluate the effect of these differences on clinical diagnosis.

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DERMOSCOPY HAS PROVEN to be a valuable tool in the diagnosis of pigmented and nonpigmented skin lesions,^{1,2} increasing the clinical diagnostic accuracy^{3,4} and improving physicians' confidence in their clinical diagnosis.⁵ Until recently, dermoscopes used only nonpolarized light sources to illuminate the skin, requiring a liquid interface and direct contact between the scope and the skin. With this approach, the amount of light reflected, refracted, and diffracted at the skin surface was reduced, thereby allowing the observer to visualize structures below the

stratum corneum. Nonpolarized dermoscopes have been the standard for dermoscopy training and courses and for capturing dermoscopic images for textbooks and manuscripts. However, new commercially available dermoscopes that exploit the properties of cross-polarized light have been recently introduced.⁶⁻⁸ Unlike nonpolarized light dermoscopy (NPD), polarized light dermoscopy (PD) allows visualization of deep skin structures without the necessity of a liquid interface or direct skin contact with the instrument.⁹ These instruments offer the capability of viewing the skin with (polarized light contact dermoscopy [PCD]) or without (po-

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Table 1. Distribution of Variables for All Evaluated Images

Dermoscopic Characteristics	Dermoscopic Modality, No. (%) (N = 90)		
	NPD	PCD	PNCD
Colors			
Light brown	75 (83)	67 (74)	53 (59)
Dark brown	49 (54)	63 (70)	59 (66)
Black	15 (17)	24 (27)	27 (30)
Gray	24 (27)	19 (21)	18 (20)
Red	29 (32)	28 (31)	41 (46)
White	10 (11)	9 (10)	4 (4)
Blue	9 (10)	5 (6)	5 (6)
Blue-white veil	9 (10)	1 (1)	1 (1)
Pink-red veil	1 (1)	0	17 (19)
Structures			
Lacunae	1 (1)	1 (1)	2 (2)
Milialike cysts	8 (9)	1 (1)	0
Comedoliike openings	5 (6)	5 (6)	2 (2)
Maple leaf	1 (1)	0	0
Blue ovoid	1 (1)	1 (1)	1 (1)
Spoke wheel	0	0	0
Blue globule	1 (1)	1 (1)	1 (1)
Network	33 (37)	33 (37)	29 (32)
Branched streak	2 (2)	2 (2)	3 (3)
Pseudopods	0	0	0
Dots	24 (27)	23 (26)	21 (23)
Peppering	8 (9)	5 (6)	2 (2)
Globules	14 (16)	13 (14)	13 (14)
Blotch	9 (10)	8 (9)	11 (12)
Blood vessels*	26 (29)	26 (29)	31 (34)
Patterns			
Reticular	12 (13)	11 (12)	11 (12)
Globular	2 (2)	2 (2)	2 (2)
Reticular/globular	5 (6)	4 (4)	4 (4)
Homogeneous	30 (33)	30 (33)	31 (34)
Starburst	0	0	0
Multicomponent	10 (11)	11 (12)	9 (10)
Other	28 (31)	28 (31)	30 (33)

Abbreviations: NPD, nonpolarized light contact dermoscopy; PCD, polarized light contact dermoscopy; PNCD, polarized light noncontact dermoscopy.

*Includes comma, pinpoint, glomerular, arborizing, hairpin halo, hairpin no halo, crown, and polymorphic.

larized light noncontact dermoscopy [PNCD]) a liquid interface and direct skin contact.

Although all 3 modalities (NPD, PCD, and PNCD) yield overall similar images, we observed that subtle differences do exist. The present study was designed to explore the levels of agreement between polarized and nonpolarized light dermoscopy images and to discuss the possible effect of such differences on clinical evaluation of lesions.

METHODS

LESION SELECTION AND IMAGE DATABASE

Ninety skin lesions were included in this study. Patients were recruited from the pigmented lesion clinic at the Memorial Sloan-Kettering Skin Cancer Center satellite facility in Hauppauge, NY. After oral consent was obtained, close-up clinical and dermoscopic images were obtained by NPD, PCD, and PNCD as described in the next section. All digitized images were captured in JPEG format, placed into a 2 × 2 matrix image (clinical,

NPD, PCD, and PNCD) for side-by-side comparison, and stored in the study database. The analysis was not limited to suspicious lesions; common lesions with classic clinical and dermoscopic features (ie, dermatofibromas, blue nevi, and common nevi) were also included. All of the clinically equivocal lesions were analyzed by histopathology.

INSTRUMENTS AND IMAGE CAPTURE

All images were obtained with a digital camera (Nikon Cool-Pix 4500; Nikon USA Inc, Melville, NY). The camera was white-color balanced, and all images were acquired in the "program" mode under a fixed magnification using autofocus. The dermoscopes used in this study (DermLite; 3Gen LLC, Dana Point, Calif) consisted of a photographic lens attachment, which used 8 light-emitting diodes that were polarized linearly with an annular shape polarizer in front of the diodes. The lens was designed with a removable glass faceplate, thus allowing for the acquisition of both PNCD and PCD images. In addition, the manufacturer provided a custom-made photographic lens attachment in which the polarizing filters were removed, allowing for the acquisition of conventional contact NPD images. This custom-made lens was supplied with a fixed glass plate. As preparation for this study, we performed a qualitative comparison between the images obtained with the NPD from this manufacturer and images acquired with a different instrument (Epilume; Canfield Scientific, Fairfield, NJ). We observed no discernible differences in the images obtained by the 2 instruments.

Clinical and dermoscopic images were acquired consecutively with the photographic dermoscope lenses attached to the digital camera to ensure consistency of resolution and illumination. Batteries were always fully charged. The first photograph was taken with the NPD lens. The lens was then switched to a polarized lens with the glass plate, and the lesion was rephotographed with a liquid interface between the lens and the subject's skin. Both NPD and PCD were performed with the use of 70% ethanol as the fluid interface. Finally, a photograph was taken with the polarized lens but without skin contact, the glass faceplate having been removed (PNCD).

IMAGE EVALUATION

All digitized images were captured in JPEG format. For each case, the close-up clinical image and 3 dermoscopic images (NPD, PCD, and PNCD) were placed into a 2 × 2 matrix for comparison. Images were evaluated for specific dermoscopic features described in the literature (see **Table 1**).

Three dermatologists (C.B.-A., A.L.C.A., and A.S.) trained in dermoscopy evaluated all images and filled 2 separate intake forms. To mitigate possible observer bias, the reviewing dermatologists were blinded to the study hypothesis, ie, naive to any preconceived differences between polarized and nonpolarized light images. Furthermore, to minimize the bias of consecutive evaluation of similar images, the images were arranged for evaluation in a random order with regard to diagnosis.

The first form included typical dermoscopic characteristics and structures of skin lesions as described in the Consensus Net Meeting on Dermoscopy.¹⁰ In this first part, participants were asked to choose the colors, features, or structures that were visible in each image individually. After the preliminary review of the study lesions, a second qualitative review was completed to help describe any remaining differences among the images that were not captured in the initial (presence or absence) evaluation. Qualitative data underwent manual tabulation and analysis procedures. The responses were coded by the study dermatologists for consensus results. Some responses to the qualitative image assessment were agreed to a

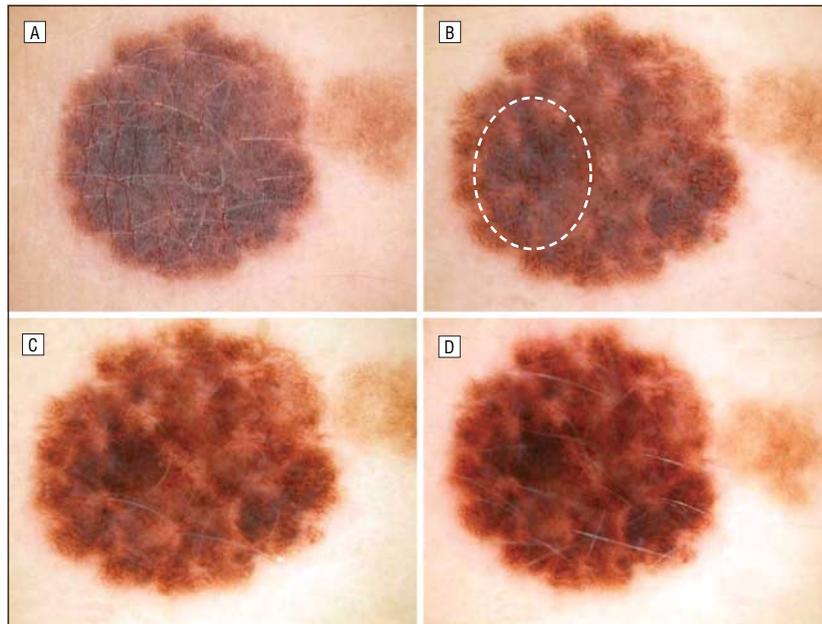


Figure 1. A dysplastic nevus shown by clinical photography (A), nonpolarized light contact dermoscopy (NPD) (B), polarized light contact dermoscopy (C), and polarized light noncontact dermoscopy (D). The dark-brown colors are more prominent under polarized light dermoscopy, and more light-brown colors are seen under NPD. In the NPD image there is a blue-white veil (highlighted by a dotted oval), which is less prominent to almost absent in the polarized dermoscopy images.

priori, while others were included as the images were reviewed. All images were subsequently evaluated by a senior dermatologist (A.A.M.) for consensus and validation.

DATA ANALYSIS

For each imaging modality (NPD, PCD, and PNCD), descriptive frequencies were calculated for all lesion dermoscopic features and for all data described on the comments form. Lesion features were assessed as present or absent. Pairwise assessments of lesion characteristics among imaging modalities were calculated as percentage agreement and κ values. The interpretation of κ values is based on the scale published by Landis and Koch.¹¹ To further describe reviewers' responses, qualitative assessments were reviewed, grouped, and tabulated. Descriptive frequencies were assessed for PCD and PNCD, with NPD serving as the standard. All statistical analyses were performed in Stata SE statistical software (version 9; StataCorp, College Station, Tex).

RESULTS

We collected images of 90 skin lesions, including 55 melanocytic lesions (18 melanomas, 6 common nevi, 5 congenital melanocytic nevi, 7 blue nevi, 16 dysplastic nevi, and 3 lentiginos) and 35 nonmelanocytic lesions (7 actinic keratoses, 5 dermatofibromas, 5 basal cell carcinomas, 13 seborrheic keratoses [SKs], and 5 squamous cell carcinomas). The dermoscopic colors, structures, and patterns were assessed by the 3 different methods (NPD, PCD, and PNCD) (Table 1).

COLORS

Light brown was observed in 75 (83%) of the lesions viewed under NPD, 67 (74%) under PCD, and 53 (59%) under PNCD (**Figure 1**). A similar trend of attenuation in prevalence was observed for white and blue-white veils (Figure 1 and **Figure 2**). Conversely, the recognition of darker colors, such as dark brown and black,

increased for PCD and PNCD compared with NPD (Figure 1). Red and pink-red veils were observed more often with PNCD than PCD or NPD (**Figures 3, 4, and 5**). The objective observation of gray (present or absent) did not appear to be affected by imaging modality.

STRUCTURES

Milialike cysts were observed in 8 (9%) of the study lesions under NPD. This observation dropped to 1 lesion (1%) under PCD and no lesions under PNCD (Figure 2 and **Figure 6**). This same trend occurred for peppering (Figure 2). Under NPD, 8 (9%) of the study lesions showed peppering, while the relative frequency decreased to 5 lesions (6%) and 2 (2%) for PCD and PNCD, respectively. In addition, the prevalence of other dermoscopic features remained relatively consistent among imaging modalities, with the exception of the presence of shiny-white stellate areas or structures, observed in some lesions (ie, basal cell carcinomas, dermatofibromas, and melanomas with regression) when viewed with PD but not with NPD (Figures 4 and 5 and **Figure 7**).

PATTERNS

The prevalence of overall dermoscopic patterns of the examined lesions remained consistent from one type of dermoscopy to the other, except for blue nevi (**Figure 8**). The classic homogeneous steel-blue pattern of blue nevi was observed only with NPD. In both PCD and PNCD, all blue nevi displayed a more heterogeneous pattern with multiple shades of blue and brown.

AGREEMENT

All dermoscopic colors, structures, and patterns that were recognized in at least 5% of the study lesions for any der-

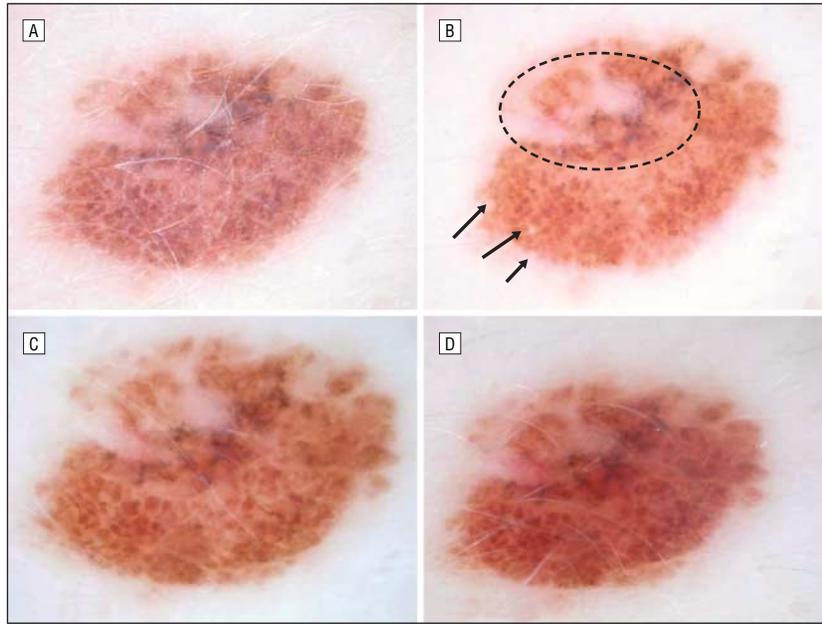


Figure 2. A congenital melanocytic nevus shown by clinical photography (A), nonpolarized light contact dermoscopy (NPD) (B), polarized light contact dermoscopy (C), and polarized light noncontact dermoscopy (D). Notice the prominent regression structures, with peppering and blue-white veil, in the NPD image (B, dotted oval). In addition, milialike cysts (arrows) can be seen in the NPD image. The regression structures become less prominent and the milialike cysts can no longer be seen under polarized dermoscopy.

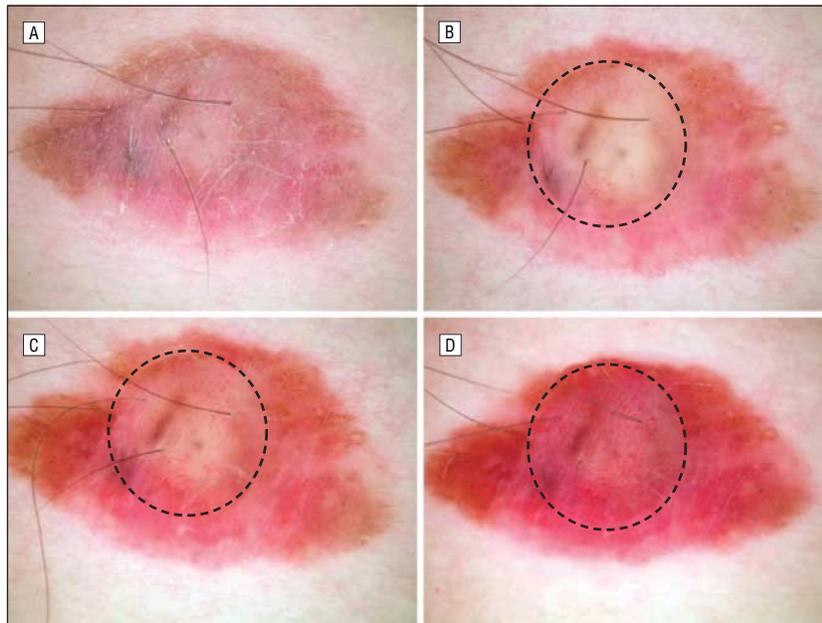


Figure 3. An amelanotic 1.6-mm melanoma (dotted circle) arising in a dysplastic nevus shown by clinical photography (A), nonpolarized light contact dermoscopy (NPD) (B), polarized light contact dermoscopy (PCD) (C), and polarized light noncontact dermoscopy (PNCD) (D). The dermoscopic structure that aids most in correctly identifying this lesion is the irregular polymorphic vessels, which are much more prominent under polarized dermoscopy (C and D). More vessels can be seen under PNCD (D) than PCD (C). Also, a prominent vascular blush (pink veil) is seen under PNCD and not PCD or NPD.

moscopy method were assessed for pairwise agreement. **Table 2** presents pairwise comparisons, as κ values, for the 3 modalities for lesion colors, structures, and patterns. Agreement was moderate to excellent for most colors, with κ values ranging from 0.45 to 1.00 for light brown, dark brown, black, gray, red, white, and blue. However, for blue-white and pink-red veil, agreement between modalities was poor. For blue-white veil, agreement for NPD-PCD, NPD-PNCD, and PCD-PNCD was poor, with κ values of 0.18, 0.18, and -0.01 , respectively. Pink-red veil showed no agreement for any of the pairwise comparisons.

Overall, dermoscopic structures exhibited fair to perfect agreement, with most κ values ranging from 0.38 to 1.00. Network, dots, globules, blotch, and blood vessels all presented relatively high levels of agreement. Milia-

like cysts, on the other hand, exhibited poor pairwise agreement, with NPD-PCD, NPD-PNCD, and PCD-PNCD κ values of 0.21, 0.00, and 0.00, respectively. Dermoscopic patterns consistently showed an almost perfect level of agreement in these lesions with the exception of the homogeneous blue nevus pattern, as described earlier (not shown in Table 2). The κ values for all pairwise comparisons ranged from 0.88 to 1.00.

QUALITATIVE EVALUATION

Many of the study lesions had noticeable changes that were not large enough in scale to shift observations from one predefined category to another, but were significant enough to note. The qualitative assessment of these changes is provided in **Table 3**. Most lesions ap-

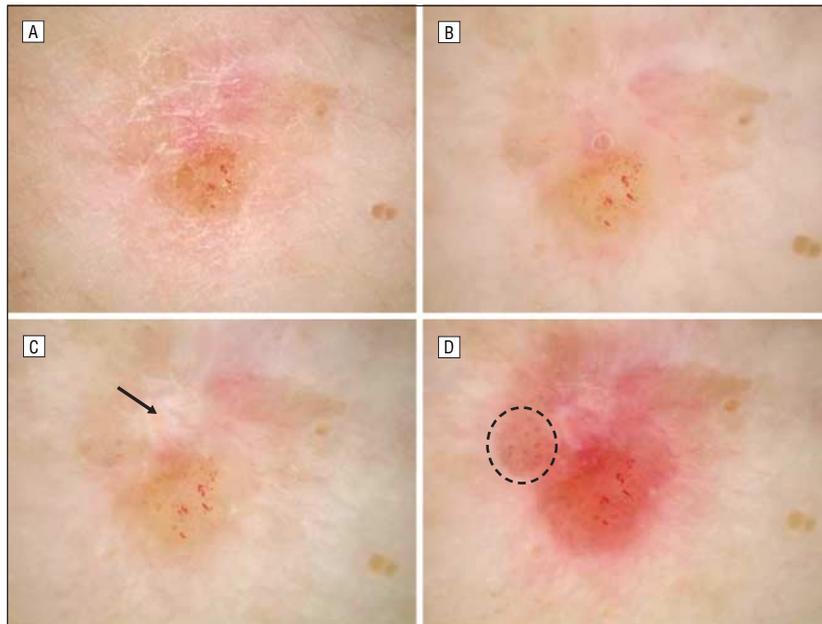


Figure 4. A basal cell carcinoma shown by clinical photography (A), nonpolarized light contact dermoscopy (NPD) (B), polarized light contact dermoscopy (PCD) (C), and polarized light noncontact dermoscopy (PNCD) (D). The PNCD image (D) shows blood vessels (dotted circle) that are not seen under NPD (B) or PCD (C). A prominent vascular blush (pink veil) is present throughout the lesion on PNCD (D) and is not visible in the NPD or PCD images (B and C, respectively). Shiny-white stellate streaklike areas can be seen in the PCD image (arrow). These shiny-white areas, which often have a stellate or streaklike appearance, are not usually seen under NPD dermoscopy but can usually be seen under PCD and PNCD (see Figure 5 and Figure 7). In this lesion, the shiny-white areas are seen clearly in the PCD image (arrow in C) but not in the PNCD image (D) because they are obscured by the prominent vascular blush.

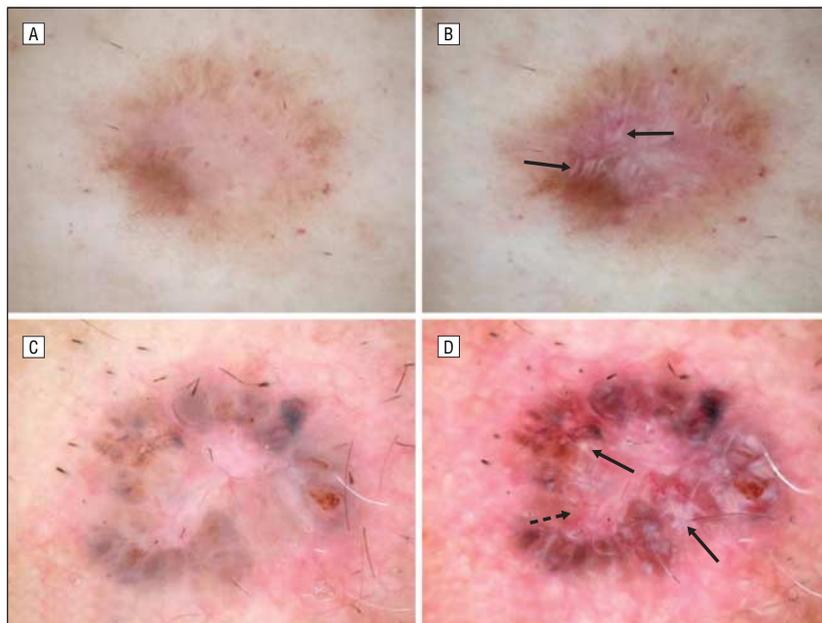


Figure 5. Appearance of dermatofibroma (A and B) and basal cell carcinoma (C and D) under nonpolarized (A and C) and polarized (B and D) light dermoscopy. Shiny-white streaks are seen in polarized images but not nonpolarized images. These streaks (arrows in B and D) may be due to polarized light being reflected by collagen present in the fibrotic stroma. Also, the brown colors appear darker and the blood vessels are more prominent under polarized light (dashed arrow in D). The central portion of the dermatofibroma shows a pink veil (vascular blush) and the basal cell carcinoma also has a pink vascular blush that is not visible in the nonpolarized images.

peared darker on PCD and PNCD than NPD (Figures 1, 2, 3, 5, 6, 7, and 8). Grays became noticeably darker under PCD (20 of 24 lesions [83%]), and structures seen as brown under NPD appeared darker under PCD (70/83 [84%]) and PNCD (58/83 [70%]). A more reddish appearance was recognized in 43 (48%) of the study lesions under PNCD when compared with NPD (Figures 3, 4, and 5). Some dermoscopic structures also changed appearance when compared with NPD images. Globules that were present on NPD became less apparent in 4 (29%) of 14 lesions under PNCD. Blood vessels became more apparent on PCD and PNCD when compared with NPD (Figures 3 and 5). Milialike cysts and comedolike openings visualized with NPD either partially or completely disappeared when viewed with PD (Figures 2, 6, and 8).

COMMENT

Dermoscopy (epiluminescence microscopy) is an in vivo diagnostic technique that magnifies skin and reduces skin surface light reflection, allowing better visualization of structures present below the skin surface, such as melanin and blood vessels. For NPD, reduction in skin surface reflection is achieved by using an immersion interface between the skin and the lens, or with light cross-polarization. During the examination, a liquid interface (ideally with a refraction index equal to that of the skin) optically links the stratum corneum (refraction index, 1.55) with a glass plate (refraction index, approximately 1.52) mounted on the dermoscope.¹² Light passing through media with similar refractive indexes tends

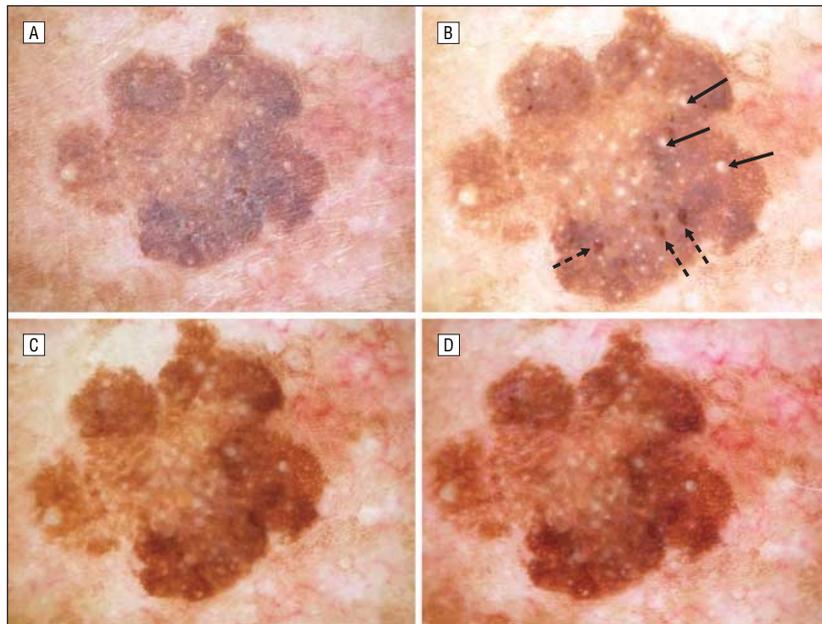


Figure 6. A seborrheic keratosis shown by clinical photography (A), nonpolarized light contact dermoscopy (NPD) (B), polarized light contact dermoscopy (C), and polarized light noncontact dermoscopy (D). The NPD image clearly shows multiple comedolike openings (dotted arrows in B) and milialike cysts (solid arrows in B). In the polarized images the comedolike openings and milialike cysts are difficult to appreciate.

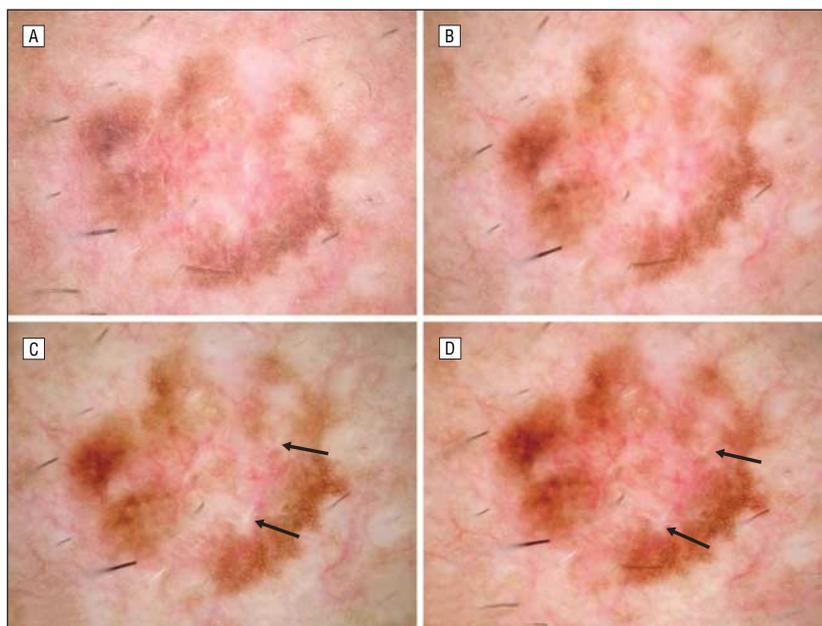


Figure 7. A melanoma shown by clinical photography (A), nonpolarized light contact dermoscopy (NPD) (B), polarized light contact dermoscopy (C), and polarized light noncontact dermoscopy (D). This melanoma had evidence of regression (fibrosis) on histopathological examination. Shiny-white streaklike areas within the melanoma (arrows in C and D), believed to represent fibrosis, are visible under polarized but not NPD.

to maintain its propagation direction. With this method, there is less light reflection and refraction on the skin surface and deeper structures can thus be visualized.

Polarized light is usually created with the use of filters (**Figure 9**). In PD, 2 filters are used in a process called *cross-polarization* (Figure 9): one filter is placed between the light source and the skin, and the second is placed between the skin and the light detector. The polarized light produced by the first filter reaches the skin and part of it is reflected at the stratum corneum, while part of it penetrates the skin and is backscattered. The superficially reflected component maintains the incidence angle and light polarization, while the backscattered light loses polarization after multiple scatterings within the skin. The second filter, used between the skin and the light detector, selectively blocks the polarized light

reflected at the stratum corneum, while the backscattered component can reach the detector (and the eyes).⁶ These filters allow the dermoscope to selectively capture backscattered light from deeper levels of the skin and avoid the superficially reflected light (responsible for the glistening appearance of the skin surface).⁶

Although most of the dermoscopy literature in the past 3 decades has been based on images obtained by NPD, the use of PD instruments is becoming more popular among dermatologists. Because the presence or absence of vascular structures, color variegation, pigment distribution, and certain dermoscopic structures are important criteria for the dermoscopic diagnosis of skin lesions,¹³ users of PNCD and PCD should be aware of the subtle differences in color and structures between cross-polarized and NPD images to avoid lesion misdiagnosis.

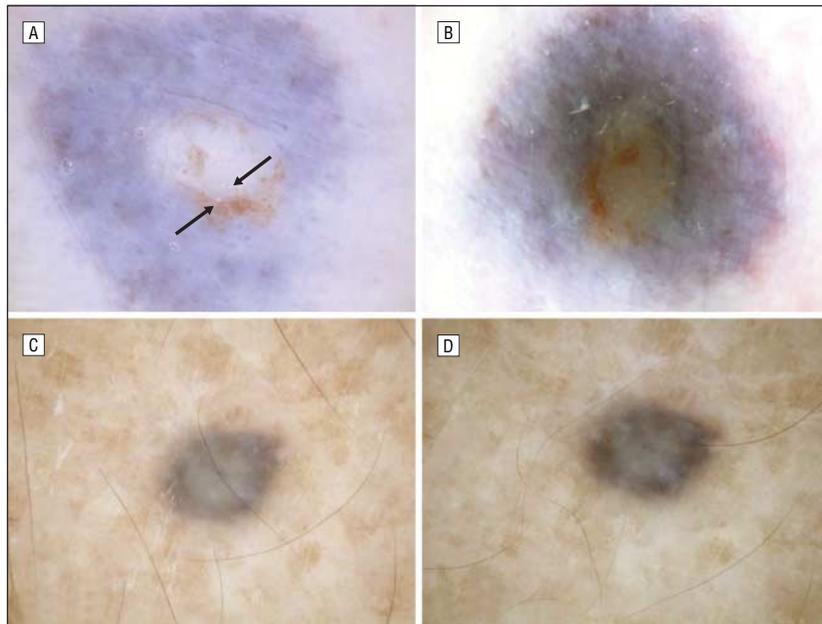


Figure 8. Appearance of congenital blue nevus (A and B) and conventional blue nevus (C and D) under nonpolarized light dermoscopy (NPD) (A and C) and polarized light contact dermoscopy (PCD) (B and D). These lesions show the classic steel-blue color under NPD, but on PCD images the color was replaced with multiple shades of blue and brown. Also, prominent milialike cysts are present in the congenital blue nevus when viewed with NPD (arrows in A) but are no longer visible under polarized dermoscopy (B).

Table 2. Pairwise Comparisons of Agreement (κ) for Dermoscopy Modalities*

	NPD-PCD	NPD-PNCD	PCD-PNCD
Colors			
Light brown	0.74	0.45	0.66
Dark brown	0.63	0.54	0.75
Black	0.71	0.52	0.81
Gray	0.73	0.57	0.76
Red	0.77	0.63	0.61
White	0.82	0.54	0.59
Blue	0.69	0.69	1.00
Blue-white veil	0.18	0.18	-0.01†
Pink-red veil	0.00‡	-0.02†	0.00‡
Structures			
Milialike cysts	0.21	0.00‡	0.00‡
Comedolike openings	1.00	0.56	0.56
Network	0.95	0.85	0.90
Dots	0.91	0.73	0.82
Peppering	0.75	0.38	0.56
Globules	0.87	0.87	1.00
Blotch	0.81	0.55	0.71
Blood vessels	1.00	1.00	1.00
Patterns			
Reticular	0.95	0.95	0.90
Reticular/globular	0.88	0.88	1.00
Homogeneous	0.95	0.93	0.98
Multicomponent	0.95	0.92	0.89
Other	1.00	0.90	0.90

Abbreviations: NPD, nonpolarized light contact dermoscopy; PCD, polarized light contact dermoscopy; PNCD, polarized light noncontact dermoscopy.

*All comparisons are significant at $P < .05$, unless indicated.

† $P > .05$.

‡The κ value could not be calculated because of lack of observations.

COLORS

It has been previously observed that colors are sharper and less distorted under conventional dermoscopy compared with PD.⁹ In this study, we found that brown and

Table 3. Description of Observations Registered During Image Analysis

Observations	Lesions With Characteristic on NPD	Comparison Modalities, No. (%)*	
		PCD	PNCD
Colors			
Gray structures look darker	24	20 (83)	20 (83)
Brown structures look darker	83	70 (84)	58 (70)
More red in lesion	90	0	43 (48)
Less red in lesion	29	6 (21)	0
Less gray in lesion	24	5 (21)	3 (3)
Less white in lesion†	16	4 (25)	6 (38)
Structures and features			
Globules partially disappear or become blurred	14	1 (7)	4 (29)
Vessels			
More visible	26	9 (35)	15 (58)
Less visible		4 (15)	3 (12)
Milialike cysts			
Partially disappear	8	2 (25)	2 (25)
Completely disappear		5 (63)	6 (75)
Shiny-white streaks become visible	90	8 (9)	7 (8)
Peppering			
Partially disappears	8	1 (13)	2 (25)
Completely disappears		1 (13)	2 (25)
Network becomes blurred	33	3 (9)	18 (55)
Scales			
More visible	90	1 (1)	3 (3)
Less visible		4 (4)	2 (2)

Abbreviations: NPD, nonpolarized light contact dermoscopy; PCD, polarized light contact dermoscopy; PNCD, polarized light noncontact dermoscopy.

*All observations compare PCD or PNCD with NPD.

†Lesions that were considered for the denominator are those that had "white" or "whitish veil" present on NPD.

blue colors appear darker under PD, and polarized light instruments seem to render different shades of brown and blue for melanin distributed in the skin when compared

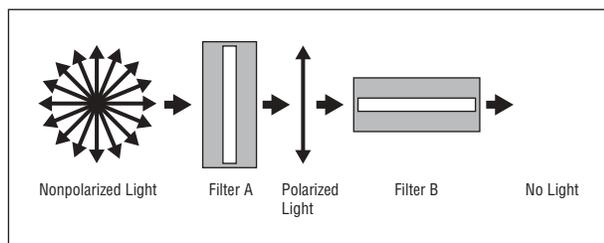


Figure 9. Effect of filtering on nonpolarized and polarized light. Light waves vibrate in a variety of directions (common nonpolarized light). When nonpolarized light is transmitted through a filter (filter A), only part of it, that with vibrations in a single plane, is allowed to emerge (polarized light). Cross-polarization occurs when polarized light is transmitted through a second filter (filter B), placed perpendicularly to the first filter. The second filter blocks the polarized light beam.

with NPD (Figures 1 and 2). Polarized dermoscopy appears to block superficially reflected light more efficiently than NPD does, and this allows for better visualization of deep structures (such as melanin) with better color contrast. Although this difference does not seem to affect the overall pattern of lesions, as shown in Tables 1 and 2, it contributed to the perception of darker shades of brown significantly altering the appearance of some lesions. Also, under PD, blue nevi displayed more shades of blue and appeared darker, with less blue-gray and blue-white veil-type areas compared with NPD (Figure 8). The homogeneous steel-blue color is a distinctive feature attributed to blue nevi in classic dermoscopy books. However, under PD most blue nevi appear more concerning, and this could influence the clinical management of these lesions. Future studies are needed to further evaluate the effect of these differences in the diagnosis and management of blue nevi.

In addition, red areas (secondary to vascular changes) could be better appreciated under PD, especially PNCD (Figures 3, 4, and 5). This could also be explained by the better visualization of deeper structures provided by polarized light, as discussed earlier. Also, PNCD, unlike the contact devices (NPD and PCD), does not involve direct pressure and hence prevents blanching of the skin, thereby allowing the clinician to observe blood vessels (Figure 3). The vascular blush observed under PNCD in lesions with dense vascularity may mask melanin distribution or other pigment structures (Figures 3 and 4). Besides, benign lesions, such as dermatofibromas, may have a different distribution of colors according to the method of dermoscopy applied. We observed in this study, and later in a specific study on dermatofibromas,¹⁴ that almost all dermatofibromas showed a central pink area under PD, unlike the pale area classically seen under NPD (Figure 5). It is reasonable to assume that PNCD's improved ability to display skin vascular structures will improve the evaluation of the distribution and shape of skin blood vessels. In clinically suspicious melanocytic lesions and basal cell carcinomas, for example, the presence and shape of vessels on NPD have been used to confirm the diagnosis of malignancy.^{15,16} The use of PD should thus improve our ability to identify cutaneous malignant lesions on the basis of the presence, quantity, distribution, and shape of blood vessels. In addition, the presence of a vascular blush, seen only with PNCD, may

improve our ability to identify skin cancer. However, further research is necessary to confirm this observation.

Interestingly, shiny-white streaklike structures could be seen exclusively with polarized light instruments (Figures 4, 5, and 7). Although our impression is that these white streaks represent fibrosis,¹⁴ their significance has yet to be verified. We recently conducted a study¹⁴ on a series of dermatofibroma dermoscopic images that has led us to believe that the shiny-white streaks represent fibrosis (collagen). The fact that this structure can be observed in dermatofibromas, scars, basal cell carcinomas, and melanomas with regression (fibrosis) supports this hypothesis.

STRUCTURES AND FEATURES

As discussed earlier, polarized light images seem to offer a better view of structures located deeper into the skin, whereas NPD allows for the visualization of more superficial structures. For example, superficial structures such as milialike cysts were less visible in PD images (Figures 2, 6, and 8). Blocking of the superficial component of light by PD attenuates visualization of superficial components. The presence of milialike cysts has been used in helping to confirm the diagnosis of SK and congenital nevi. Because milialike cysts are less visible in both PNCD and PCD, absence of these structures during PD examination may affect clinical diagnosis of SK. Similarly, this appears to apply for comedolike structures, also usually present in SK (Figure 6).

On the other hand, as described for the colors, polarized instruments allow better visualization of vascular patterns and pigment distribution, which could be very useful for the differential diagnosis of skin tumors, such as basal cell carcinomas, squamous cell carcinomas, and melanocytic tumors (Figures 3, 4, and 5).

Finally, our images showed that peppering was less visible under PD than classic NPD. Either the small gray dots appear darker (brown) or disappear in some polarized light images because of the darker color of the surrounding pigment (Figure 2). Peppering, along with blue-white areas and gray color, is usually a sign of regression in pigmented lesions, and these areas could be overlooked with the use of PD (Figures 1 and 2).

Our findings suggest that, although PD and NPD yield overall similar patterns and images, they have some differences that provide complementary information (**Table 4**). While NPD permits the visualization of structures located in the upper layers of the skin, with attenuation of the lower layers, PD permits visualization of deeper structures. We hypothesize that some of the differences described herein for SK, blue nevi, dermatofibromas, and vascular structures may influence diagnosis and management, but additional studies are required to verify this.

As an additional point of interest, the differences described are also significant for patient follow-up and dermoscopy training. Cutaneous surveillance has been described as an effective method of melanoma detection.¹⁶⁻¹⁹ Although not pathognomonic, color changes, the appearance of a vascular component, and changes in the network pattern observed in a lesion over time are used as signs of malignant development. The use of different

Table 4. Summary of Pertinent Differences Between NPD, PCD, and PNCD*

	NPD	PCD	PNCD
Colors			
Melanin pigment	+	++	++
Red or pink	+	++	++++
Blue-white	+++	++	+
Structures			
Peppering	+++	++	+
Shiny-white streaks	+/-	+++	++
Blood vessels	+	++	++++
Milialike cysts and comedolike openings	++++	+/-	+/-
Patterns			
Homogeneous blue pattern of a blue nevus	Homogeneous blue color	Heterogeneous with different shades of blue	Heterogeneous with different shades of blue

Abbreviations: NPD, nonpolarized light contact dermoscopy; PCD, polarized light contact dermoscopy; PNCD, polarized light noncontact dermoscopy.
*Plus signs indicate degree to which feature can be visualized, with the greater number of plus signs indicating greater visualization; +/- signs indicate that sometimes the feature can be seen and sometimes not.

modalities to obtain pictures over time may influence the comparison of colors, vasculature, and even pigment distribution. If possible, the same type of instrument should be used during all visits. It also seems imperative that textbooks and scientific articles clearly describe the instruments used for obtaining images. With time, we may start to realize that PD demonstrates features not described under nonpolarized light, adding new perspectives to skin lesion evaluation.

One limitation of this study was the sample size. Because this study only included 90 lesions, stratified analyses by lesion type were not possible. We chose to include a broad spectrum of lesion types in this study because of the novelty of the imaging technique. To our knowledge, this is the first study describing the differences among these imaging modalities. One earlier study described differences between polarized videomicroscopy and NPD.⁸ However, polarized videomicroscopy images are low resolution, making observations of differences, especially subtle differences, quite difficult. Regardless, some of the results from the polarized videomicroscopy study correspond well to our findings. Further work needs to be completed to describe these initial observations in larger groups of specific lesion types. Another limitation is that the lesions for this study were also not randomly chosen. Lesions were selected through convenience sampling and are not representative of our larger patient population. Nonetheless, the study lesions were chosen before dermoscopic evaluation so as to limit the possibility of inclusion bias.

CONCLUSIONS

Can we reliably use the terminology applied for classic dermoscopy while using the new cross-polarized der-

moscopes? The answer seems to be yes, but exceptions do exist. When deciding on an instrument, dermatologists should recognize the potential benefits and limitations inherent in each. According to this study, we could summarize these differences as follows (Table 4): melanin looks sharper and darker on PD, and it seems to influence the appearance of blue nevi; vessels are better visualized by PNCD, suggesting that PD may be helpful in identifying malignancies; milialike cysts and comedolike openings are easier seen with NPD, facilitating recognition of SK; peppering, lighter colors, and blue-white structures are more evident under NPD, making NPD advantageous in the evaluation of regression areas; and shiny-white streaks, probably representing fibrosis, are seen much more clearly under PD. Their presence in melanocytic lesions may indicate fibrotic regression, while their presence in dermatofibromas is of diagnostic importance. The complementary nature of the methods can be an advantage for skin evaluation because new criteria can be added to the current guidelines for dermoscopic diagnosis. On the basis of the observations of this study, we intend to further evaluate findings of specific lesion types, such as blue nevi, as already conducted with dermatofibromas, to study the influences of these findings for lesion diagnosis and management.

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ARCHIVES Web Quiz Winner

Congratulations to the winner of our December quiz, Radhakrishna Bhat, MD, Consultant Dermatologist, Manipal Hospital, Bangalore, India. The correct answer to our December challenge was *aneto-derma*. For a complete discussion of this case, see the Off-Center Fold section in the January ARCHIVES (Pascual J, Giménez E, Sivera F, Martínez A. Atrophic macules and soft papules in a 24-year-old woman. *Arch Dermatol*. 2007; 143:109-114).

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