Atlas of Dermoscopy

Second Edition

Edited by
Ashfaq A. Marghoob
Josep Malvehy
Ralph P. Braun

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Published in 2012 by Informa Healthcare, 119 Farringdon Road, London EC1R 3DA, UK.

Simultaneously published in the USA by Informa Healthcare, 52 Vanderbilt Avenue, 7th Floor, New York, NY 10017, USA.

Informa Healthcare is a trading division of Informa UK Ltd. Registered Office: Informa House
30–32 Mortimer Street, W1W 7RE. Registered in England and Wales number 1072954.

A CIP record for this book is available from the British Library.
Library of Congress Cataloging-in-Publication Data available on application.

ISBN: 978-0-415-45895-5
eISBN: 978-1-84184-762-7

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Typeset by Exeter Premedia Services Pte Ltd., Chennai, India
Printed and bound in the United Kingdom

Dedication

To Alfred W. Kopf, mentor par excellence, who introduced me to dermoscopy and encouraged me not to settle for mediocrity.

To Allan Halpern, a chief unmatched, for providing the opportunity and means for me to pursue my passions and for allowing me to reach heights I could never have imagined.

To my fellows, residents, and students, for all your valuable insights, inquisitive nature, and hard work. You have all profoundly influenced my career and knowledge. I will remember each and every one of you forever!

To my children, Adam, Nadeem, Hannah, and Samir, remember to strive to do your best in all endeavors you undertake. Always be just, kind, and loving. Remember your Creator and thank Him every hour of every day for all that He has provided for you.

To Iman, my wife of more than 25 years, thank you for standing by my side. I could not have journeyed so far without your love, support, help, and patience.

To my parents, Mamnoon and Monika, for your love and for providing me with the foundation to successfully navigate through this life. To you both I owe everything!

To my sister, Azra, for always being there for me.

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To my son Alexander
To my parents Ulrike und Paul, for always beeing there for us.

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Foreword

While the diffusion of dermoscopy into routine dermatology practice has been quicker in some circles than in others, there is little question it is now routinely used by most dermatologists. Increasingly, the dermoscopy audience has broadened beyond dermatologists and the focus is no longer exclusively on pigmented lesions. With the wider adoption of the technique has come affirmation of its utility, with multiple lines of evidence supporting an associated improvement in diagnostic accuracy, earlier detection of melanoma, and a reduction in unnecessary biopsies. One of the critical resources that helped educate the current generation of dermoscopists was the outstanding first edition of the *Atlas of Dermoscopy*. It is therefore a genuine privilege to write this brief forward to the new and improved 2nd edition of this important reference work.

The quality of the second edition of the *Atlas of Dermoscopy* comes as no surprise to anyone familiar with its distinguished contributors. The authors are all leaders in the field who have helped lay the academic foundations for the subjects they cover. The editors are renowned not only for their expertise but also as gifted educators. Through the outstanding courses and conferences they have organized they have educated many dermoscopists, myself included. The current iteration of this book will serve a growing readership and will help novice and experienced dermoscopists alike to improve their knowledge and skills.

The second edition has much important new material. Unlike most dermoscopy atlases, it highlights the differences observed with polarized and non-polarized dermoscopy. In keeping with the rapidly expanding dermoscopic literature, it details many newly recognized structures and patterns and addresses the many new areas benefiting from dermoscopy such as evaluation of the hair and nails. I especially enjoyed how the authors, throughout the atlas, have attempted to highlight principles on integrating dermoscopy into general clinical practice and I also like the inclusion of checklists of criteria used to diagnose skin lesions.

My congratulations to all those who contributed to this excellent volume and to you the reader, who I am confident will benefit from their labors.

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1 Introduction

Ashfaq A. Marghoob, Ralph P. Braun, and Josep Malvehy

The time for clinicians to use dermoscopy in evaluating and managing cutaneous malignancies is fast approaching. Currently, many dermatologists are using dermoscopy (Noor et al., 2009; Terushkin et al., 2010; Venugopal et al., 2011) and questions pertaining to dermoscopy have become part of the final qualifying examinations for many dermatologists. There is also a mounting interest being expressed by general practice (GP) physicians (i.e, family physicians), subspecialty physicians, nurse practitioners, and physician's assistants in learning dermoscopy. The added benefit of dermoscopy has been documented for dermatologists, GPs, and even medical students. In other words, the use of dermoscopy has begun to diffuse beyond the hands of dermatologists. Dermoscopy has even become part of the clinical practice guidelines in some countries. In the publication "Clinical Practice Guidelines for the Management of Melanoma in Australia and New Zealand," the training and utilization of dermoscopy is recommended for clinicians routinely examining pigmented skin lesions. These guidelines are evidence-based best practice guidelines with grade A evidence, which means that the body of evidence can be trusted to guide practice.

The editors opine that it is only a matter of time for the truth to be known to all that the use of dermoscopy makes for a better clinician. With that said, let us explore some of the reasons for why clinicians should learn to use dermoscopy (Table 1.1).

1. *Dermoscopy significantly improves the in vivo diagnostic accuracy of melanoma.* Dermatologists only diagnose 65–80% of melanomas on routine naked-eye examination. For example, in the Oncology Section of the Skin and Cancer Unit of NYU Langone Medical Center the diagnostic accuracy was found to be only 64% using strict criteria (e.g., allowing a single diagnosis for all lesions) (Grin et al., 1990). Dermoscopy improves diagnostic accuracy by 10–27% (Kittler et al., 2002).
2. *Dermoscopy can differentiate most lesions of the skin from melanoma.* With naked-eye examination it is not unusual to come upon a pigmented lesion, which has some or all of the clinical attributes of melanoma, but on dermoscopy the lesion can be definitively diagnosed as some other type of cutaneous lesion.
3. *Dermoscopy reduces unneeded biopsies.* Studies have shown that the "benign/malignant ratio" of pigmented lesions of the skin is decreased when dermoscopy is used compared with visually unassisted diagnoses (Carli et al., 2004).
4. *Basic instrumentation for dermoscopy is affordable.* Compared with some other available instruments used by dermatologists (e.g., reflectance confocal microscopy), dermoscopes are relatively inexpensive, thus making such technology affordable for most practitioners.
5. *Dermoscopes are easy to use.* Placing liquid or gel onto the skin prior to placement of the glass plate of the dermoscope onto the lesion allows the clinician to view the lesion, through the magnifying ocular lens of the dermoscope, with exceptional clarity. The liquid interface, by matching the refractive index of the stratum corneum and glass plate, allows the clinician to visualize structures below the surface of the skin. The advent of polarized dermoscopes, however, has eliminated the necessity for a liquid interface or direct skin contact (see chapter 2 for details).
6. *Several helpful algorithms have been created to aid in classifying lesions of the skin.* These algorithms have been created primarily for those who are beginning to use dermoscopy. Details on a number of such algorithms are presented in chapters 4 and 6b–h.
7. *Dermoscopy has added a new powerful dimension to the clinical diagnosis of early melanoma.* The qualities of a "good test" are accuracy, no adverse effects, target disorder dangerous if left untreated, and effective treatment if diagnosed early (Jaeschke et al., 1994). Dermoscopy has all of these attributes since the target disorder, melanoma, if diagnosed and removed early in its evolution, is curable.
8. *Dermoscopy is a noninvasive technique that allows microscopic visualization of subsurface skin structures not visible to the naked eye.* Thus, the use of dermoscopy does not require additional expense to the patient for invasive procedures, such as the performance of biopsy, cost of processing the biopsy specimen, and interpreting the dermatopathologic diagnosis. Eliminating unneeded biopsies translates to overall reduced health care costs.
9. *Adding dermoscopy to complete skin examinations is not overly time consuming.* Zalaudek et al. (2008) have shown that, on average, complete skin examination takes 70 seconds without dermoscopy and 142 seconds with dermoscopy. The authors conclude that complete skin examination, with or without dermoscopy, usually takes less than 3 minutes. They profess this is a reasonable time to potentially prevent mortality from cancers of the skin.
10. *Meta-analysis of the literature has demonstrated the superiority and usefulness of dermoscopy.* Numerous studies (Vestergaard et al., 2008; Bafounta et al., 2001) have provided data to indicate that the diagnostic accuracy of dermoscopy is superior to that of naked-eye examination.
11. *Dermoscopy allows the observer to focus (concentrate) on the lesion.* The procedure forces a pause during the busy total cutaneous clinical examination allowing time to think and formulate a logical differential diagnosis. Dermoscopy provides another chance to rethink the naked-eye examination conclusion allowing for a second opportunity to make the correct diagnosis.
12. *Dermoscopy helps differentiate melanocytic from nonmelanocytic lesions.* This concept is explained in chapter 10 on the "two-step" initial dermoscopic procedure, which differentiates melanocytic from nonmelanocytic lesions.
13. *Dermoscopy increases the observers' confidence in their clinical diagnoses.* It has been shown that, compared with naked-eye examination of lesions of the skin, dermoscopy engenders greater degree of confidence in the correctness of the clinical diagnosis (Wang et al., 2008). The procedure also assures the patient that additional steps have been taken regarding the decision whether or not the lesion should be biopsied. When the confidence in a dermoscopic examination of a lesion reaches 100% that the lesion is benign, biopsy is almost always avoided.
14. *Dermoscopy helps isolate suspicious foci within larger lesions.* Identifying such foci can be useful for directing pathology sectioning of such suspicious sites within a lesion (Marghoob et al., 2009).
15. *Dermoscopy can aid in more precisely defining borders of some lesions for improved presurgical margin mapping.* An example of this is the ability to recognize subclinical extensions of facial lentigo maligna melanomas using dermoscopy (Robinson, 2004).
16. *Dermoscopy helps in the surveillance of patients with many melanocytic nevi.* In such patients certain lesions have attributes that do not meet the full criteria for melanoma but have

Table 1.1 How Can Dermoscopy Help?

Allows observer to concentrate on lesion and formulate a logical differential diagnosis
Helps differentiate melanocytic from nonmelanocytic lesions
Helps differentiate benign from malignant lesions
Improves diagnostic accuracy
Increases the observers' confidence in their clinical diagnoses
Confirms naked-eye diagnosis (clinical–dermoscopy correlation)
Improves malignant to benign biopsy ratio (avoids unnecessary biopsies)
Helps isolate suspicious foci within lesions—directing pathology step-sectioning—clinical–dermoscopy–pathology correlation
Helps more precisely define borders of some lesions for improved presurgical margin mapping
Helps in the surveillance of patients with many nevi
Helps reassure patients

Source: From Benvenuto and Marghoob (2006).

some "suspicious" features. By using a comparative approach and short-term (i.e., every three months) sequential dermoscopic digital imaging, the lesions that appear similar to each other or remain unchanged or changed in a benign way can be followed (Altamura et al., 2008; Argenziano, 2011).

Now, a word regarding the second edition of this atlas. This edition has been completely rewritten with the aim of providing the most up-to-date information possible regarding dermoscopy. The editors solicited experts in this field to contribute chapters pertaining to their respective area(s) of interest and expertise. However, many chapters were subsequently edited and/or substantially rewritten by Dr. Ashfaq A. Marghoob and Ralph Braun with the aim of providing a more interwoven view of the subject matter. For this we ask the authors of the edited chapters for forgiveness. Schematics, to help readers visualize certain dermoscopic structures, were added to many chapters by Josep Malvehy. Furthermore, many of the submitted dermoscopic images were replaced by better examples from the editors' personal image database. This was all done so as to provide a textbook on dermoscopy that will speak to the reader with one unified point of view. It is our sincere hope that this book will help novices and experts in the field of dermoscopy to improve upon their dermoscopic skills. Without doubt, we, the editors, poured our hearts and souls into this work and thereby further perfected our own dermoscopy knowledge and skills. For this we will forever be indebted to all those that contributed to this atlas.

Melanoma writes its message on the skin with its own ink, and it is there for all to see. Unfortunately, some see but do not comprehend.
Neville Davis (Davis, 1978).

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2 Principles of dermoscopy and dermoscopic equipment

Steven Q. Wang, Ashfaq A. Marghoob, and Alon Scope

INTRODUCTION

Dermatoscopy, which is most commonly referred to daily as dermoscopy, uses a handheld microscope called a dermatoscope (or dermoscope) that is equipped with a magnification lens and a light source. This device allows the observer to examine the subsurface primary morphology of cutaneous lesions. In the hands of experienced users, dermoscopy can improve the clinician's diagnostic accuracy (Bafounta et al., 2001; Kittler et al., 2002) and confidence level (Benvenuto-Andrade et al., 2006) for both pigmented and nonpigmented skin lesions. Although unaided (naked) visual inspection of the skin allows the clinician to appreciate the gross morphologic features of lesions, such as their size, shape, colors, contours, and topography, dermoscopy allows the clinician to visualize structures below the level of the stratum corneum to the depth of the superficial dermis. In other words, dermoscopy has opened up a new dimension in the morphologic evaluation of skin lesions by revealing colors and structures that are normally not visible to the unaided eye.

Rona MacKie, in the 1970s, was one of the first clinicians to recognize the advantage of dermoscopy for the preoperative evaluation of equivocal pigmented skin lesions (MacKie, 1971; MacKie, 1972). Thereafter, many clinicians and researchers worldwide have studied it extensively, and a significant progress has made in defining dermoscopic patterns and structures of pigmented and nonpigmented skin lesions. Today, there remains little doubt that dermoscopy is a valuable clinical tool for the noninvasive, in vivo evaluation and diagnosis of cutaneous lesions.

PRINCIPLES OF NONPOLARIZED DERMOSCOPY

Dermoscopy provides additional information beyond that gleamed by evaluating the lesion through a simple magnifying lens. To understand how dermoscopy provides this information requires an understanding of the optical principles involved in dermoscopy, in particular, the interactions of light with the skin. Because the refractive index of the stratum corneum is higher than that of air, much of the incident light is reflected off the surface of the skin (Fig. 2.1); (Anderson & Parrish, 1981; Pan et al., 2008) this diffuse backscattered light overwhelms the retina, and thereby obscures the visualizing of light that is reflected from the deeper layers of the skin. Consequently, with naked-eye examination, we are mostly able to observe the morphologic features manifest on the surface layer of the skin (stratum corneum), and only minimally able to appreciate the colors and structures located in the deeper layers of the epidermis and the dermis.

The first handheld dermoscope introduced into clinical practice used a nonpolarized light source to illuminate the skin. Most nonpolarized dermoscopes (NPDs) today contain light-emitting diodes to provide illumination, and all NPDs are equipped with a 10× magnification lens (Fig. 2.2). Examining lesions with NPD necessitates direct contact of the dermoscope's glass plate with the skin, between which the presence of a liquid interface is required (ideally with refraction index equal to that of skin) (Fig. 2.3). This setup replaces the normal skin–air interface with a skin–liquid interface. Because there is a closer match of refractive indices within the skin–liquid–glass interface, light reflection is decreased, thereby minimizing glare, which in turn makes the stratum corneum appear more translucent. This optical setup permits the observer to see deeper structures in the skin (Fig. 2.4). It should now be obvious that when utilizing NPD it is imperative that air pockets (i.e., air bubbles) present between the dermoscope's glass plate, the liquid, and the skin be eliminated; such air pockets create a skin–air interface that will preclude the observer from visualizing structures below the stratum corneum.

Different immersion liquids can be used for dermoscopy, including water, mineral oil, alcohol or gel (i.e., ultrasound gel, antibacterial gel). In one study (Gewirtzman et al., 2003), 70% alcohol was reported to be the best immersion liquid since it yielded fewer air bubbles and provided clearer images. An added benefit of alcohol is the potential for it to reduce bacterial contamination, and thus it may be more hygienic as compared with other liquids (Stauffer et al., 2001). However, for examination of the nail apparatus, ultrasound or antibacterial gels are much superior to alcohol (Ronger et al., 2002; Kelly & Purcell, 2006), because the gel's viscosity prevents it from rolling off the convex nail surface. It is common to have air bubbles trapped in the gel and the bubbles can be distracting and may prevent the observer from getting a clear view of the lesion. In efforts to minimize the number of air bubbles in the gel it is best to store the gel bottles upside down, to avoid shaking the bottle, and to squeeze out a small amount of the gel before use so as to discard remnant dried gel.

PRINCIPLES OF POLARIZED DERMOSCOPY

Polarized dermoscopy (PD) units were introduced into the clinical arena in the year 2000 (Fig. 2.5). These handheld dermoscopes rely on a different set of optical principles from those described above for NPD. The PD devices use two polarizers to achieve cross-polarization. Under this condition, the polarizers allow the dermoscope to preferentially capture the backscattered light from the deeper layers of the skin (mechanism is explained in Fig. 2.6). The main advantages of the cross-polarized system are that it eliminates the necessity of a liquid interface and it does not require direct contact with the skin (Fig. 2.7). These innovations allow the examiners to scan lesions at a relatively rapid pace. Although PD does not require direct contact and a liquid interface, some PD devices do allow the user to opt between noncontact PD and contact PD, which can be used with or without the application of fluid onto the skin. In addition, dermoscopes that allow the user to toggle between PD and NPD are now available. When these "hybrid" dermoscopes are used for toggling between the PD and NPD modes, the dermoscope should be in direct contact with a liquid interface. If this is not done then the user will see dermoscopic structures only in the polarized mode; however, in the nonpolarized mode, no dermoscopic structures will be discernable and the observer will simply see a magnified clinical (not dermoscopic) image of the lesion.

POLARIZED VS. NONPOLARIZED DERMOSCOPY

For most pigmented and nonpigmented skin lesions, PD and NPD offer overall similar images. However, there are some important differences between the two types of dermoscopes (Table 2.1) (Agero et al., 2006; Benvenuto-Andrade et al., 2007; Wang et al., 2008).

In general, blue-white color (Fig. 2.8A, B) due to orthokeratosis or regression, and milia-like cyst (Fig. 2.9A, B) are more conspicuous under NPD. However, blood vessels (Fig. 2.10A, B), vascular blush due to increased blood volume (Fig. 2.11A, B), and white shiny areas (i.e., scar or chrysalis/crystalline) (Fig. 2.8A, B) are more conspicuous under PD. Besides the features mentioned above, there are also slight color differences between PD and NPD. The PD instrument displays the melanin pigment with varying and darker shades of brown and blue compared with NPD (Fig. 2.12). Although most of the aforementioned differences between PD and NPD are due mainly to the inherent properties of polarized *versus* nonpolarized light, some are due to the effects of pressure being placed (contact dermoscopy) or not being placed (noncontact dermoscopy) onto the skin surface (Figs. 2.10–2.12). As mentioned previously, NPD requires a liquid interface and contact with the skin. The pressure applied from the NPD scope against the skin can compress small blood vessels in a lesion, making it difficult to visualize them (Fig. 2.10); in fact, as little as 18 mmHg pressure is required to blanch out the

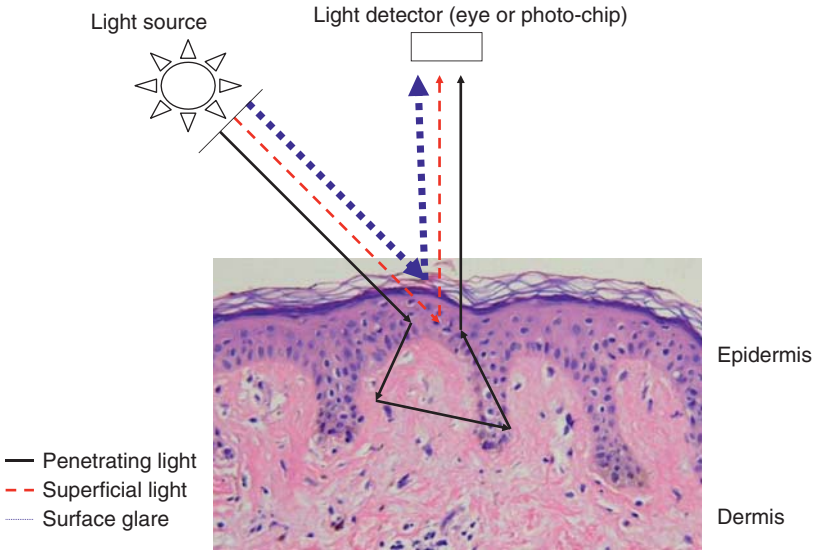


Figure 2.1 This is a schematic representation of optical properties of light without the use of dermoscopy. The arrows indicate the path of light through the skin. Some of the light is absorbed by the superficial layers of the epidermis and is scattered only slightly (thin red line) and some of the light penetrates more deeply and undergoes more scattering events (thin black line). However, most of the incident light is reflected off the stratum corneum (thick blue line); this surface glare overwhelms the retina, and thereby precludes the observer from visualizing the light reflected from the deeper layers of the skin (red and black lines). Thus, practically speaking, the clinical (nondermoscopic) examination of the skin with or without a magnifying lens only sees the light that is reflected from the skin surface (thick blue line), and thus most subsurface structures remain hidden from view.

Figure 2.2 The most frequently utilized nonpolarized contact dermoscopes are shown in this figure. From left to right these scopes are: Episcope (Welch Allyn; www.welchallyn.com); DermLite Fluid (3GEN, LLC; www.dermlite.com); Delta 20 (Heine; www.heine.com); DermoGenius (Biocam; www.dermogenius.com)

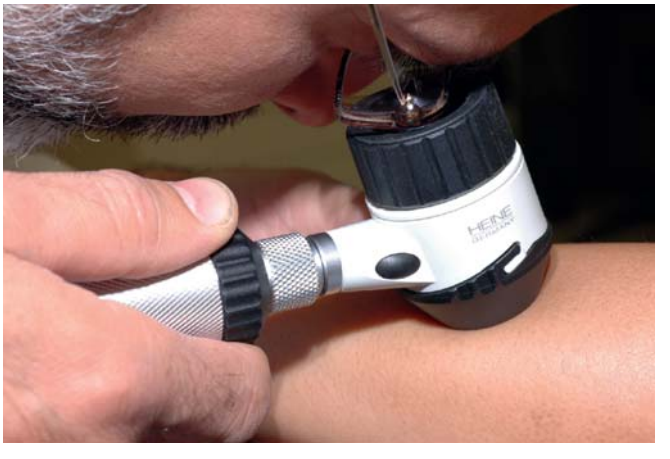


Figure 2.3 Physician examining the skin with a contact nonpolarized dermoscope.

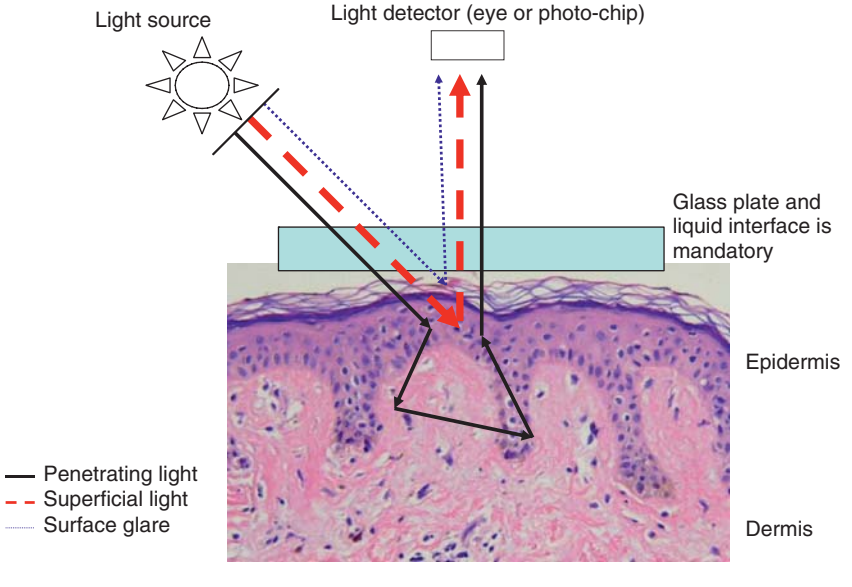


Figure 2.4 This is a schematic representation of optical properties of light during the use of contact NPD with a liquid interface. The arrows indicate the path of light through the skin. Most of the light is absorbed and reflected from the superficial layers of the epidermis after undergoing minimal scattering events (thick red line). Some of the light is reflected off the stratum corneum (thin blue line) but this surface glare is insufficient to interfere with the ability to visualize subsurface dermoscopic structures. Some of the light penetrates more deeply and is absorbed and reflected back after multiple scattering events (thin black line); however, the light from the deeper layer contributes only a small fraction to that detected with NPD, and most of the light reaching the retina is from the more superficial, minimally scattered light (thick red line). *Abbreviation*: NPD, nonpolarized dermoscopy.

Figure 2.5 Numerous polarized dermoscopes are currently availably. The scope on the far left is called the DermScope (Canfield Scientific, Inc., Fairfield, NJ, USA). This scope is designed to be attached to an iPhone and thus it functions as a video dermoscope. It has the added benefit of allowing the observer to toggle between NPD and PD modes. The other scopes shown here are all DermLites (3GEN, LLC, Dana Point, CA, USA). The DermLite Hybrid M and DL3 permit the clinician to toggle between NPD and PD mode. Similar to Canfield, 3GEN also has dermoscopic attachments for the iPhone (center, bottom image).

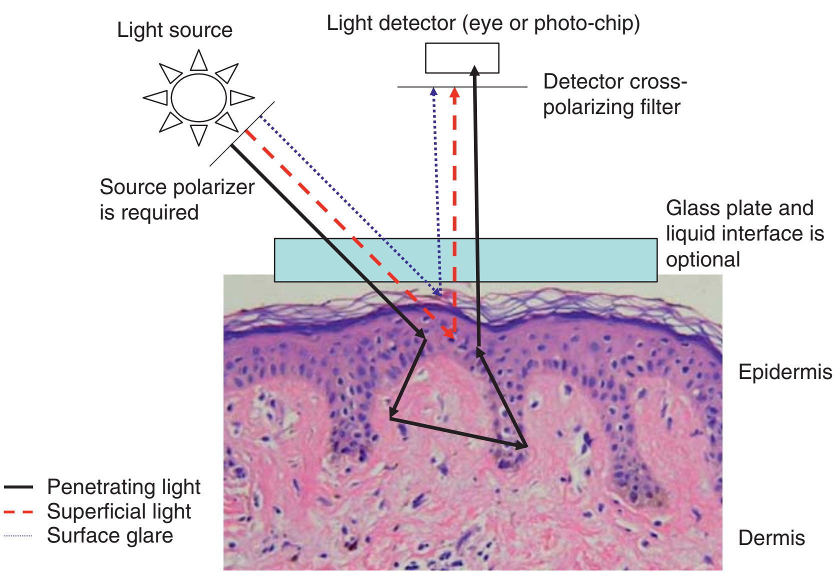
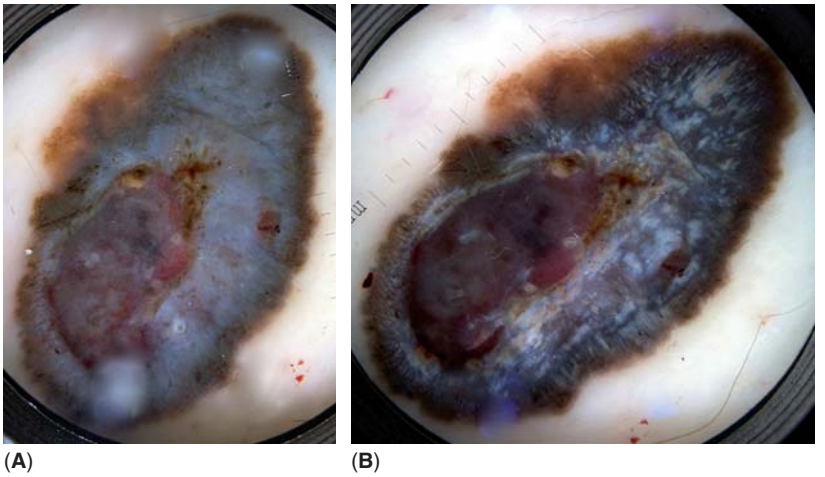


Figure 2.6 This is a schematic representation of optical properties of light during the use of polarized dermoscopy. Light emitted from the dermoscopy unit (source) passes through a polarizer resulting in the generation of polarized (unidirectional) light; light reflecting back toward our eye (detector) must first pass through a cross-polarized filter whose direction is perpendicular (orthogonal) to that of the source polarizer. Thus, polarized light cannot pass through the cross-polarizing filter unless the light changes its direction by 90°, which can only occur if the original polarized light begins to undergo sufficient scattering that changes its direction (randomization of polarization). Light reflected from the stratum corneum maintains its original polarization, and thus cannot pass through the cross-polarized filter (blue line). Light that is absorbed at the superficial layers of the epidermis, but does not undergo enough scattering events to result in randomization of polarization, will also be blocked by the cross-polarizing filter (red line). Only light penetrating more deeply and/or undergoing multiple scattering events will result in randomization of polarization. When this light is reflected back, it will be able to pass through the cross-polarization filter, thus allowing the observer to visualize dermoscopic structures. While PD does not require direct contact and a liquid interface, some of the devices have the option for contact PD.

Figure 2.7 Physician examining a cutaneous lesion with a polarized noncontact dermoscope.

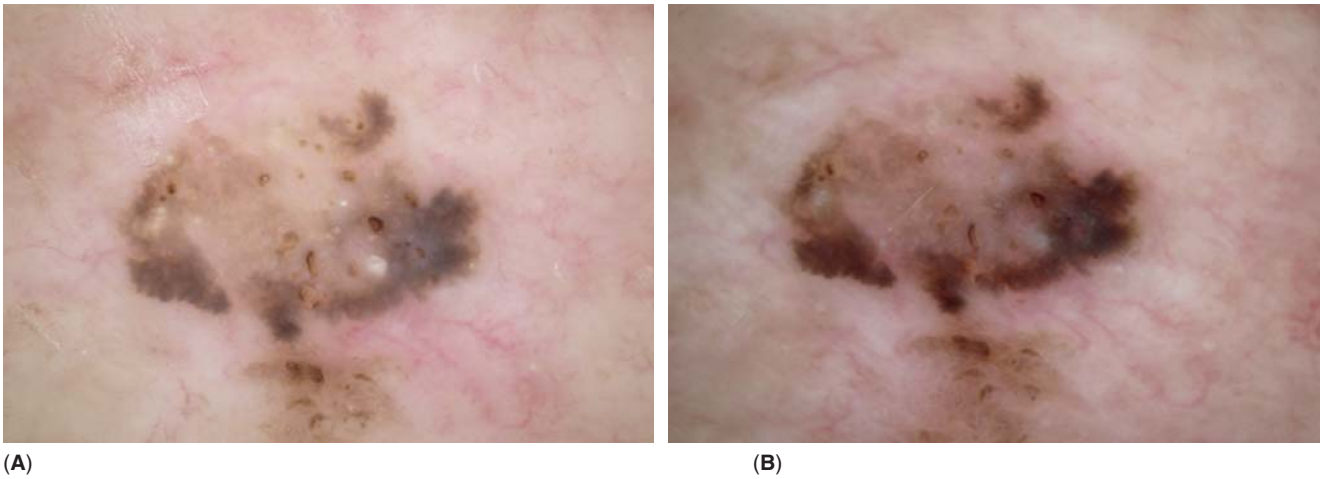
Table 2.1 Relative Differences Between Nonpolarized Dermoscopy and Polarized Dermoscopy

Colors and structures	Nonpolarized dermoscopy	Polarized dermoscopy
Colors		
Melanin	+	++
Red/pink	+	+++
Blue-white due to orthokeratosis	+++	+
Blue-white due to regression	+++	++
Structures		
Peppering	+++	++
Chrysalis or white scar	+/−	+++
Vessels	+	+++
Milia-like cyst	+++	+/−



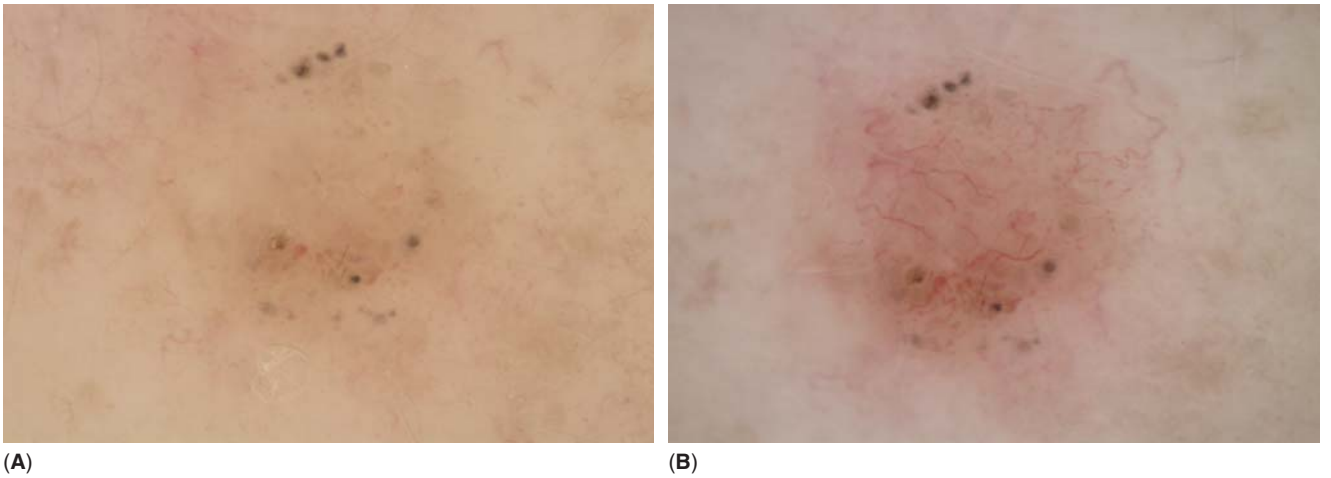
(**A**) (**B**)

Figure 2.8 Image was taken with (**A**) NPD and (**B**) PD. This is a melanoma 0.9 mm in thickness. Notice that the blue-white veil at the center of the lesion is more conspicuous under NPD and is difficult to appreciate with PD. However, linear white shiny streaks, known as chrysalis/crystalline structures can only be seen with PD. Blue white veil is due to orthokeratosis and will be seen with a device that preferentially images the superficial layers (NPD), whereas chrysalis/crystalline structures which are thought to correlate with altered collagen in the stroma, are only visible with a device that preferentially images deeper layers (PD). *Abbreviations*: PD, polarized dermoscopy; NPD, nonpolarized dermoscopy.



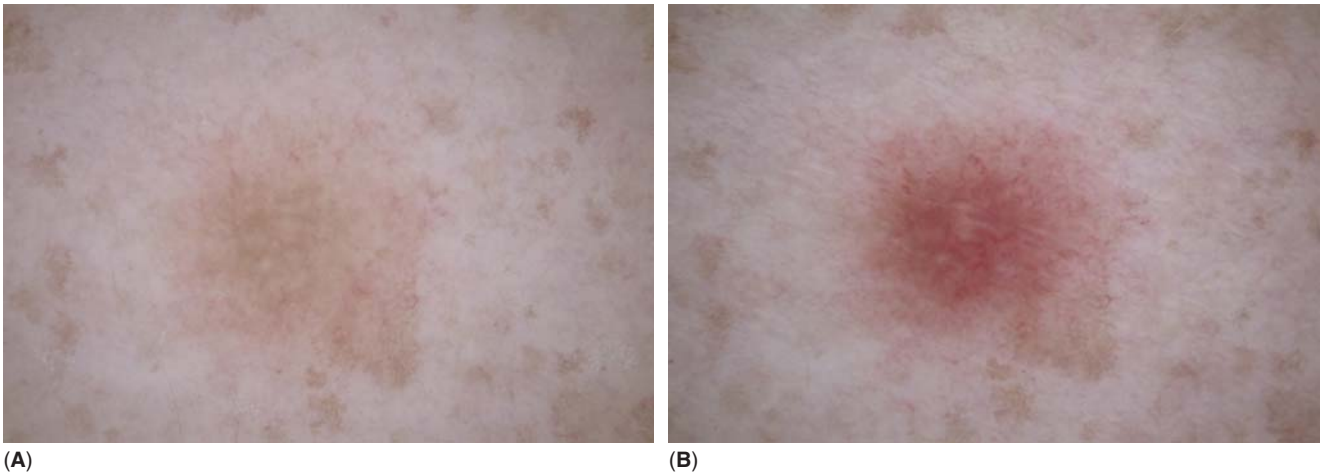
(**A**) (**B**)

Figure 2.9 Image was taken with (**A**) NPD and (**B**) PD. This is a seborrheic keratosis. Because milia-like cysts are not visible under PD, this lesion could be misdiagnosed as a melanoma. However, with NPD, the milia-like cysts are readily identifiable and the correct diagnosis can be rendered with ease. *Abbreviations*: PD, polarized dermoscopy; NPD, nonpolarized dermoscopy.



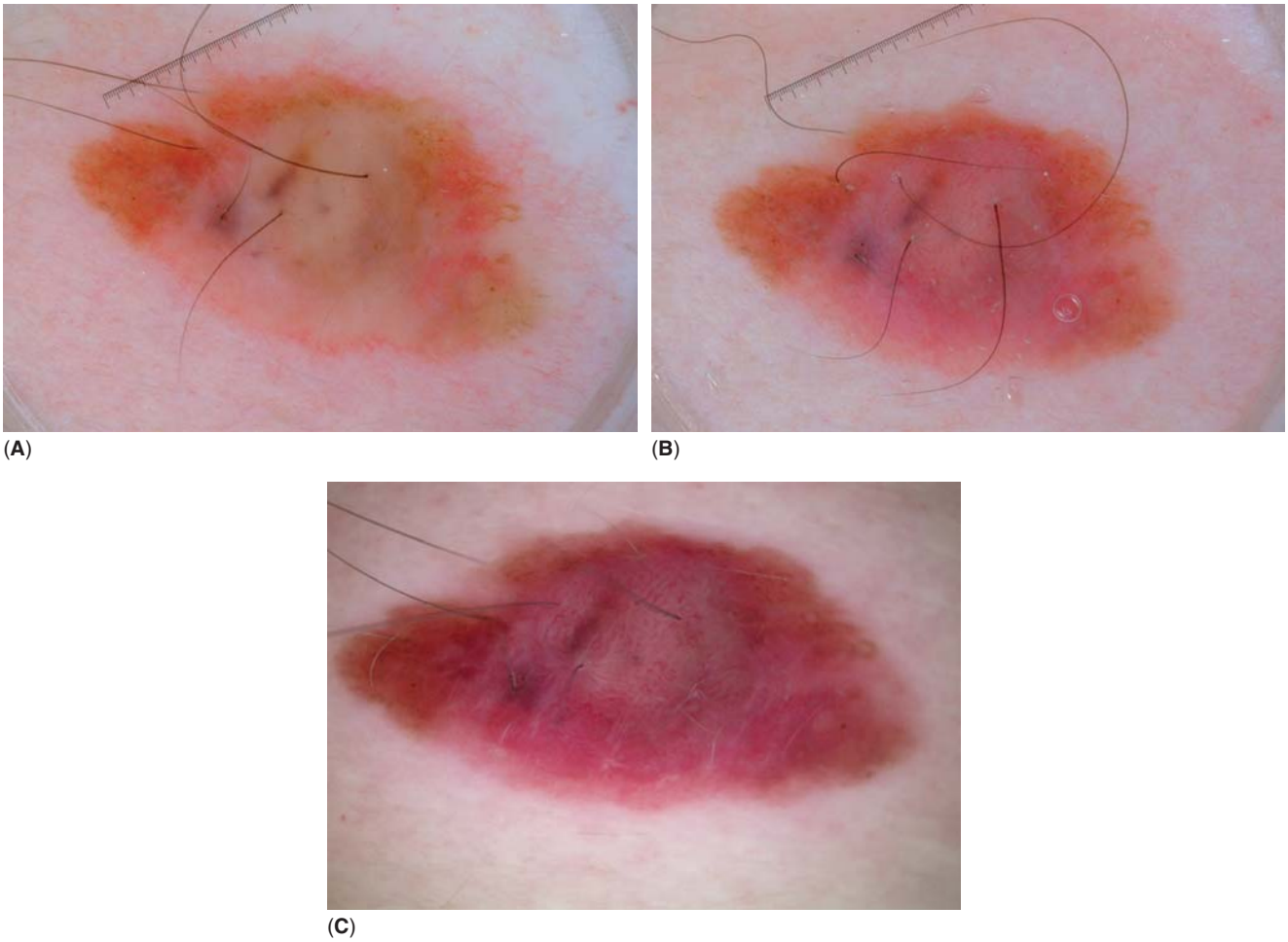
(**A**) (**B**)

Figure 2.10 Image was taken with (**A**) NPD and (**B**) PD. This is a basal cell carcinoma. Notice that the arborizing blood vessels are better seen with PD than with NPD. This is partially due to the compression of blood vessels during the examination with NPD and partially due to the enhanced ability to visualize deeper structures with PD. *Abbreviations*: PD, polarized dermoscopy; NPD, nonpolarized dermoscopy.



(**A**) (**B**)

Figure 2.11 Image was taken with (**A**) NPD and (**B**) PD. This is a melanoma 0.3 mm in thickness. Notice that the vascular blush (pink veil, due to vasodilation) is better seen with PD than with NPD. This is partially due to the compression of blood vessels during the examination with NPD and partially due to the enhanced ability to visualize blood and red colors with PD. *Abbreviations*: PD, polarized dermoscopy; NPD, nonpolarized dermoscopy.



(**A**) (**B**)

(**C**)

Figure 2.12 The three images are of the same melanoma 1.65 mm in thickness arising in a pre-existing nevus. Image (**A**) was captured with an NPD using alcohol as the liquid interface. Image (**B**) was captured using NPD and ultrasound gel as the liquid interface. Image (**C**) is taken with PD without any direct contact with the skin. These images highlight the effects of placing pressure on the lesion. PD without direct skin contact (*image C*) allows for the blood vessels and vascular blush to be most apparent. Using gel as the liquid interface during NPD allows the operator to apply less pressure on the lesion as compared with NPD when alcohol is used as the fluid interface. As can be seen in the figure, minimizing the pressure being applied onto the skin during NPD examination (*image B*) will greatly enhance the ability to visualize the blood vessels. Besides the effects of pressure, this case also highlights some of the inherent difference between nonpolarized and polarized light. Notice that chrysalis/crystalline structure can be seen in the PD image (*bottom*) but is not apparent in the two NPD images. *Abbreviations*: PD, polarized dermoscopy; NPD, nonpolarized dermoscopy.

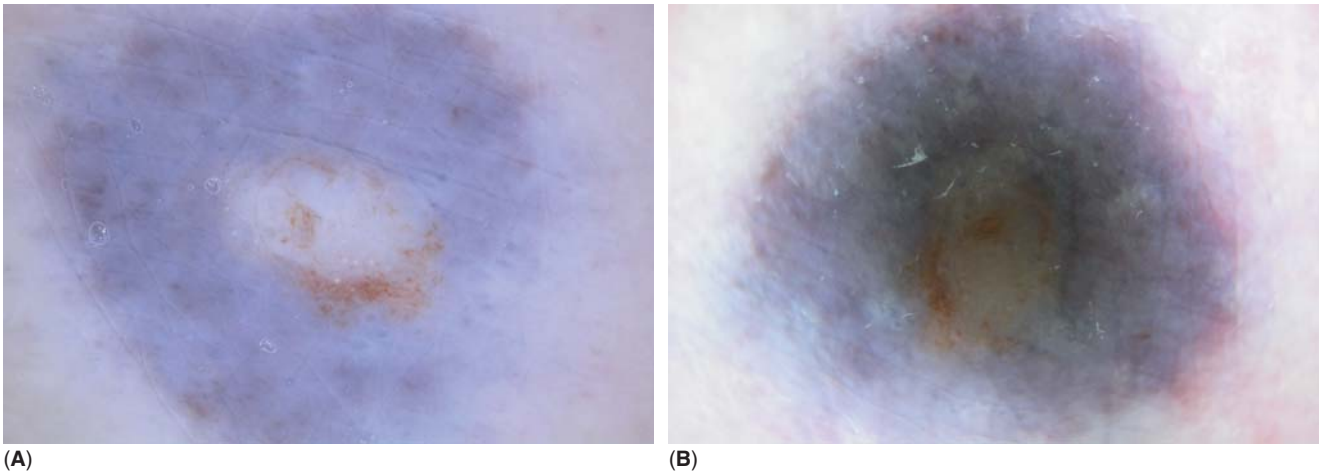


Figure 2.13 Image taken with (**A**) NPD and (**B**) PD. This is a combined blue nevus. Blue nevi can appear differently on NPD and PD. Under NPD, the lesion has a more homogeneous blue appearance, whereas under PD, the lesion displays varying shades of brown and blue. *Abbreviations*: PD, polarized dermoscopy; NPD, Nonpolarized dermoscopy.

Figure 2.14 Most handheld dermoscopes can be coupled to a camera via an adapter. In this image the handheld DermoGenius is attached to a Nikon camera and the handheld DermLite is attached to a Cannon camera.

Figure 2.15 Acquiring images through a dedicated dermoscopic camera lens tends to be less cumbersome. In addition, the image quality is usually better and more reproducible as compared to the image quality acquired with a handheld unit attached to a camera. The dedicated dermoscopic camera lenses shown in this figure are (1) EpiLume dermoscopy lens produced by Canfield is shown attached to a Nikon camera (*left*), (2) Heine Dermaphot lens is shown attached to a Minolta camera (*middle*), (3) DermLite Foto lens produced by 3GEN is shown attached to a Cannon camera (*right*).

blood volume within a lesion (Fig. 2.11). Since PD does not require direct skin contact, blood vessels and pink color are more evident under PD. Furthermore, polarized light must transverse a distance of between 0.06 and 0.1 mm of skin before sufficient amounts of polarized light changes its angle of polarization (randomization of polarization, Fig. 2.6), thereby allowing it to pass through the cross-polarizing filter thereby allowing it to reach our retina. In other words, unlike NPD, PD is "blind" from the skin surface to a depth of about 0.06–0.1 mm. This is the reason why milia-like cysts (horn pseudocysts in the epidermis) and blue-white veil (orthokeratosis), both due to superficial changes in the epidermis, are less conspicuous with PD (Figs. 2.8 and 2.9). Although PD is not ideal for evaluating the superficial layer of the skin, it does allow for improved visualization of deeper skin layers compared with NPD. This helps explain why melanin pigment can appear in varying shades of brown and blue (Tyndall effect) under PD (Fig. 2.13). It also helps explain why the blood vessel morphology is more conspicuous under PD (Fig. 2.10). In addition, polarized light rapidly randomizes its polarization when it encounters a birefringent structure, such as collagen. This property helps explain why scars and chrysalis/crystalline structures are more conspicuous under PD (Fig. 2.8) (Marghoob et al., 2009).

Although most lesions can be correctly diagnosed via either NPD or PD, one study demonstrated that the differences between PD and NPD may impact the diagnostic accuracy and diagnostic confidence level (Wang et al., 2008). For example, some seborrheic keratosis may be misdiagnosed with PD due to the inability to visualize the milia-like cysts with polarized light (Fig. 2.9B). However, the same seborrheic keratosis is likely to be easily diagnosed with NPD (Fig. 2.9A). As another example, some amelanotic or structureless melanomas may only be identifiable due to the presence of blood vessels, vascular blush, and/or chrysalis/crystalline structures. These structures are all easy to appreciate with PD and often difficult to impossible to visualize with NPD (Figs. 2.8 and 2.11). It is clear that PD and NPD provide complementary information. PD provides maximum sensitivity for detecting a cutaneous malignancy while NPD provides maximum specificity by correctly identifying lesions such as seborrheic keratosis. Thus, using both may provide the clinician with the highest diagnostic accuracy.

CAPTURING DERMOSCOPIC IMAGES

Many clinicians are inclined to document the dermoscopic appearance of lesions by capturing an image of the lesion with a camera. Fortunately, adapters are available for most handheld dermoscopes that permit coupling of the dermoscope to the camera (Fig. 2.14). In addition, dedicated dermoscopic camera lenses are also available and they tend to be less cumbersome to use as compared with handheld units attached to a camera (Fig. 2.15). These

Table 2.2 Dermoscopic Devices with the Added Features of Digital Image Capture and Analytic Algorithms

Device name[a]	Function	Company	Website
DB-Dermo Mips	ANN and "similarity" classifier	Biomips srl	www.skinlesions.net
DermoGenius Ultra	ABCD characteristics and Digital Standardized Dermatological Point Score (DSDP)	BIOCAM GmbH	www.biocam.de
Fotofinder Dermoscope	Comparison with a reference bank	TeachScreen Software	www.fotofinder.de
MicroDerm	DANAOS–ANN clasifier	VisioMED	www.visiomedag.com
MoleMate	Spectrophotometric intracutaneous analysis	Astron Clinica	www.astronclinica.com
Molemax III	ABCD and seven-point score	Derma Medical Systems	www.dermamedicalsystems.com
Solarscan	Comparison with a reference bank	Polartechnics	www.polartechnics.com.au

Clinical and dermoscopic digital image capture for all instruments. All dermoscopic images are taken with a liquid interface except DB-Dermo Mips, which uses polarized light. [a]Device names are registered trademarks. *Abbreviation:* ANN, artifical neural network.

dedicated lenses generally result in the easier acquisition of sharper and clearer images as compared with images acquired through handheld units. Lastly, numerous companies are now producing dermoscopic lenses that can easily be attached to iPhones (Fig. 2.5). The dermoscopic image quality acquired via the camera on a mobile phone device is on par with those taken via more traditional methods.

Most images captured today are digitally acquired. These images can easily be stored on hard drives, CDs, DVDs, and others. However, easy retrieval of relevant images may pose a challenge. Multiple image database programs are available that can facilitate in the process of organizing and retrieval of images. In addition, multiple systems are commercially available consisting of a dermoscopic imaging device, which is directly linked to a computer. These systems simplify the process of image acquisition, storage, organization, retrieval, and image viewing. Many of these systems have the added benefit of providing computer-based analytical algorithms to assist clinicians in managing skin lesions (Table 2.2).

CONCLUSIONS

1. Dermoscopy allows for the visualization of colors and structures present not only on the surface of the skin but also in the epidermis and dermis.
2. Correct interpretation of structures seen under dermoscopy can improve the clinician's diagnostic accuracy and confidence level for both pigmented and nonpigmented skin lesions.
3. There are differences between the images seen with nonpolarized and polarized dermoscopes. Both types of devices provide complementary information. In general, structures in the superficial epidermis (e.g., milia-like cysts) are more conspicuous with nonpolarized dermoscopes, and deeper structures (e.g., blood vessels, collagen) are more conspicuous with polarized devices.
4. To capture dermsocopic images, various imaging devices are available.

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