Differences in dermoscopic images from nonpolarized dermoscope and polarized dermoscope influence the diagnostic accuracy and confidence level: a pilot study

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DIFFERENCES IN DERMOSCOPIC IMAGES FROM NON-POLARIZED DERMOSCOPE AND POLARIZED DERMOSCOPE INFLUENCE THE DIAGNOSTIC ACCURACY AND CONFIDENCE LEVEL.

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ABSTRACT

Objective: To evaluate whether the differences in colors and structures observed in dermoscopic images from non-polarized dermoscopes (NPD) and polarized dermoscopes (PD) can impact physicians' diagnostic ability and their confidence levels.

Participants: 100 dermatologists who attended a one-day course on the fundamental of dermoscopy course at Memorial Sloan-Kettering Cancer Center.

Design: Twenty five pigmented lesions were chosen, which consisted of 7 seborrheic keratoses, 3 basal cell carcinomas, 2 atypical nevi, 5 melanomas, 3 dermatofibromas, 3 blue nevi and 2 hemangiomas. Two images of each lesion (one NPD and one PD) for a total of 50 lesions were included in the image presentation. Participants were not informed of the study design and were not told that they would be viewing the same lesions under 2 different imaging modalities. Statistical analysis examining the participants' responses was performed using the McNemar's test and Paired t test.

Main Outcome Measures: The main outcomes included the assessment of the diagnostic accuracy and confidence level for clinicians viewing lesions via NPD and PD.

Results: Ninty-one participants completed the study. Statistically significant differences in the diagnoses were observed in the seborrheic keratosis, atypical nevus and melanoma groups. For seborrehic keratosis, 75% and 59% of the final participants correctly diagnosed SK when presented with the NPD and PD images, respectively. For atypical nevi, 19% and 33% had the correct diagnoses when presented with NPD and PD images, respectively. For melanomas, 23% and 34% had correct diagnoses with the NPD and PD images, respectively. For the categories of seborrehic keratosis and atypical nevus, participants were statistically more confident in their diagnoses when presented with the NPD images than with the PD images. For the category of basal cell carcinoma, participants were more confident in their diagnosis when viewing the PD images compared to the NPD images.

Conclusion: There are observed differences between NPD and PD in term of the color and structure visualized. In some cases, physicians diagnostic accuracy and confidence are affected by the differences seen with the different dermoscopes. NPD and PD appears to provide different but complementary information.

INTRODUCTION

Dermoscopy is a valuable tool for the diagnosis of pigmented and non-pigmented skin lesions[1, 2]. In the hands of experienced users, the device helps to improve clinical diagnostic accuracy[3, 4], and increase physicians' confidence[5] in their clinical diagnoses. The standard dermoscope (NPD) uses non-polarized, halogen or incadenscent light sources. These dermoscopes require the application of immersion liquids[6] to enhance the penetration of light through the stratum corneum, thereby allowing the observer to see deeper structures within the skin. These were the only type of devices available in 1990s. As a result, nearly all of the dermoscopic structures, patterns, and diagnostic algorithms that have been described thus far are based on NPDs technology. Furthermore, dermoscopic images shown in most textbooks and in many lectures and courses are taken with cameras coupled to NPDs.

Over the past several years, polarized dermoscopes[7, 8 9] (PD) have emerged on the market. These dermoscopes use the properties of cross-polarized light to view deeper skin structures[9], not visible to the unaided eye. They are smaller in size, and they do not require a liquid interface. They offer the capability of viewing the skin with or without direct skin contact. The use of PD is becoming more prevalent among dermatologists, especially the residents.

It was generally thought that PD and NPD are similar and the dermscopic images obtained with NPD and PD were comparable in quality. However, studies have demonstrated some striking differences in the colors and dermoscopic structures observed with NPDs and PDs[8, 10]. In this study, we evaluated whether these differences can impact

physicians' diagnostic accuracy and confidence levels in examining pigmented skin lesions.

METHODS

Subjects:

Dermatologists and dermatology residents with a beginner level of experience in dermoscopy attended a day long course on the fundamentals of dermoscopy at Memorial Sloan-Kettering Cancer Center. After the morning lectures, 100 of the registered physicians participated in a study to assess their ability to diagnose lesions based on dermoscopic images. A short survey was administered to all study participants to assess their level of familiarity and/or expertise with dermoscopy.

For this study, twenty five lesions were randomly chosen from a database of pigmented skin lesions with clinical images, NPD and PD images, and histologic confirmation. Only lesions with good image quality were chosen. Lesion selections were made by one of the study dermatologists (AAM). Seven categories of pigmented lesions were included in the study: 7 seborrheic keratoses, 3 basal cell carcinomas, 2 atypical nevi, 5 melanomas, 3 dermatofibromas, 3 blue nevi and 2 hemangiomas. Two images of each lesion (one standard non-polarized dermoscopic, and one polarized non-contact dermoscopic) for a total of 50 lesions were included in the image presentation. The order in which the study images were presented was randomized. The orientation (rotation) of the study images was different from NPD to PD in an effort to make the lesions less familiar. Participants were not informed of the study design and were not told that they would be viewing the same lesions under 2 different imaging modalities. Study lesions

were presented to all of the participants, in a darkened lecture hall. Participants were given a wireless hand-held audience response keypad on which to record their responses. For each image, the participants were asked, the following questions: (1) "What is your diagnosis of this lesion?" (See Table 1 for the choices) and (2)"How confident are you in you diagnoses on a scale of 1-5," with 1 indicating very confident and 5 indicating not confident at all. All 50 study lesions were presented in the same manner.

Statistical Considerations:

Distributional characteristics of all study variables were examined. Descriptive frequencies, means and medians were used to describe keypad response data. McNemar's test was used to assess differences in diagnosis between NPD and PD. Paired t-tests were used to assess differences in confidence in diagnosis between NPD and PD evaluation. A general estimating equations approach was used to explore differences in physician confidence between NPD and PD. Separate regression models were created for each diagnostic lesion category. All analyses were performed with Stata SE v.9.1, College Station, TX.

RESULTS:

A total of 100 physicians participated in the study. Technical difficulties with the audience response system rendered 5 respondents' data unusable. Four respondents had very incomplete data, >75% missing, so their responses were omitted from the analysis. The final sample size included 91 participants. The level of dermoscopy experience of the participants varied, and majority of the participants were novices. On average, for each lesion pair, 85% of the observers provided a diagnosis.

The percentages of participants with the correct diagnoses for each category of lesions are shown in Table 2. There were statistically significant differences in the diagnoses of seborrheic keratosis, atypical nevus and melanoma. In the seborrheic keratosis group (figure 1), 75% of the final participants had correctly diagnosed SK when presented with the NPD images, and 59% had the correct diagnoses with the PD images. Sixteen percent of the responses were misdiagnosed as MM when presented with the NPD images, and 28% misdiagnosed as MM with the PD images. In the atypical nevus group (figure 2), 19% and 33% had the correct response when presented with NPD and PD images, respectively. In the melanoma group (figure 3), 23% and 34% had correct diagnoses with the NPD and PD images, respectively. There was no statistical difference for the BCC (figure 4), blue nevus, DF, and hemangioma group (Table 2).

The confidence level of the participants is shown on Table 3. There was no statistical difference in the confidence levels for the blue nevus, DF, hemangioma, and melanoma groups. For the categories of SK and atypical nevus, participants were more confident with their diagnoses when presented with the NPD images than with the PD images. For the categories of BCC, the participants were more confident with their diagnoses when presented with the PD images.

DISCUSSION:

Dermoscopy is an effective technique that allows the physicians to visualize structures deep in the skin that are normally not visible on unaided eye exam. With proper training, clinicians improve their diagnostic accuracy and confidence levels in the diagnosis of both pigmented and non-pigmented skin lesions.

During the examination using NPD, a liquid interface (ideally with refraction index equal to skin) is needed to optically link the stratum corneum with the glassplate of the dermoscope[6]. This interface allows more light to penetrate into the skin, so that deep structures can be visualized. The polarized dermoscopes, both the contact and the non-contact types, work by a different principle. These devices utilize two filters to achieve some degree of cross-polarization. These filters allow the dermoscope to preferentially capture the backscattered light from the deeper levels of the skin.

Until the introduction of PD in 2003, NPD was the only type of dermoscope available to the clinicians. Because of its small size and ease of use (no need for liquid interface), PD soon became popular among the dermatologists, especially with residents. However, there are some differences when comparing PD with NPD[8, 10]. In general, the PD allows better visualization of structures deep in the skin, like blood vessels. However, epidermal structures, such as comeodone-like openings (hyperkeratinized clefts), are better seen with the NPD. In addition, Benvenuto-Andrade et al[8] suggested that there may be slight color differences between PD and NPD. The polarized light instruments seem to render different shades of brown and blue for melanin distributed in the skin when compared to NPD. Red areas, correspond to vascular changes, are better appreciated under PD (figure 3-4).

In this study, we wanted to see whether subtle difference between the PD and NPD instruments will influence the diagnoses of physicians who are learning to use dermoscopy. Our results are mixed. For blue nevi, hemangioma, and dermatofibroma, there were no differences in the participants' diagnostic accuracy or confidence levels. For BCC, more participants had the correct diagnosis when presented with the NPD

images, but the difference was not statistically significant. In general, the PD images of BCC have more telangiectasias (fig 4) and red color. The presence of fewer vessels in NPD images is partially due to the pressure of NPD dermoscope on the lesion compressing the vessels. For seborrheic keratosis, atypical nevi, and melanoma, there was a significant statistical difference in diagnostic accuracy when the participants were presented with NPD and PD images of the same lesions.

The most dramatic difference is observed in the diagnoses of seborrheic keratosis. Nearly 16% more participants made the correct diagnoses when presented with the NPD images. In addition, there was also an increased confidence level in their diagnoses when presented with the NPD images. This result can be explained by the different optical properties of the dermoscopes. In PD, the backscattered light from the superficial skin is partially blocked. Hence, the superficial structures, such as the intraepidermal milia cysts (milia-cyst on dermoscopy) and hyperkeratinized clefts (comedo-like openings on dermoscopy) are not easily visualized. Both milia-like cysts and comedo-like openings are two valuable clues for diagnosing seborrheic keratosis[11]. For the participants who are learning dermoscopy, missing these two key clues on PD images led to more inaccurate diagnoses. When presented with PD images, 12% more of the final participants incorrectly diagnosed a SK as a MM (See Figure 1). This finding is clinically significant and can impact patient management. For beginners who use PD devices, the diagnostic accuracy may actually decrease for some lesions. This could potentially lead to an increased rate of biopsy of lesions such as SK. However, it is important to keep in mind that this study has only 25 lesions in the entire test set, and 7 seborrheic keratoses. The small test set is a major limitation of this study. In addition, some of the seborrheic

keratoses lesions were difficult lesions to diagnose. Partially because the lesions were difficult, they were biopsied and included in the database. The participants in this study are beginners. It is likely that expert dermoscopists may perform better with the PD images, because they may rely on more diagnostic clues other than the milia-like cysts and comedo-like openings.

For both atypical nevi and melanoma, more participants made the correct diagnosis with PD images, compared to NPD images. Participants were more confident with the NPD images for diagnosing atypical nevi, but not for melanoma. However, for both categories of lesions, the diagnostic accuracy was relatively low. This can be attributed to the inexperience of the participants and the difficult nature of the lesions. However, the findings still show that the diagnostic decisions of the participants were influenced by the differences in PD and NPD images. Further research is needed to determine whether this will hold true for more experienced dermoscopists as well.

The results of our study show that the difference in colors and dermoscopic structures seen with PD and NPD devices can potentially influence the diagnostic accuracy and the confidence levels of the diagnosis in novice users. The importance of accurate diagnosis is intuitively obvious. The increased accuracy translates into a decreased number of biopsies and improved benign to malignant biopsy ratio. Perhaps equally important, the confidence level of the diagnosis also impacts our clinical decisions. One can be very confident about a wrong diagnosis. This may lead to dire clinical outcomes, such as missing the diagnosis of a melanoma. Conversely, one can have little to no confidence in a correct diagnosis, and this scenario can lead to excessive biopsies of many benign lesions. The shift of confidence levels for BCCs, atypical nevi

and seborrehic keratosis in our study serves as another measurement demonstrating the differences in the PD and NPD images. Our study looked predominantly at beginners, and whether these differences can impact experienced users still needs to be explored. We suggest that future publications and lectures on dermoscopy mention the type of device, specifically PD or NPD, used to capture the images.

In terms of deciding which dermoscope to use, ideally, it would be best to have a dermoscope that combines the attributes of PD and NPD, allowing the users to see superficial and deep structures in the skin equally well. For the beginners who rely on atlases for guidance, it is perhaps easier to use an NPD initially. The reasons for this include: 1) currently most dermoscopy atlases and images presented in dermatologic publications are taken with NPD devices, and 2) NPD devices are better for visualizing milia-like cysts and comedo-like openings; both features are important to diagnose seborrehic keratosis, a lesion that very often can clinically mimic MM. However, for experienced users who have extensive knowledge and experience with NPD, the addition of PD as an adjunct may prove valuable. Vessels are better visualized with PD, and morphologies of vessels are recognized to be important to diagnosing both pigmented and non-pigmented skin lesions. However, regardless which dermoscope one decides to use, one needs to understand the limitation and advantage of each type of device.

In summary, we demonstrated that differences exist between NPD and PD, and in some cases, physician confidence is affected by which imaging technique is used. The differences that we have highlighted may be due to differences in colors and dermoscopic structures seen between PD and NPD. In this study, these differences had an impact on the diagnostic accuracy of beginners who are learning dermoscopy.

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