Dermoscopy for melanoma detection in family practice

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Abstract

Objective To assess the diagnostic accuracy and clinical utility of dermoscopy for melanoma detection in family practice.

Quality of evidence Ovid MEDLINE (1946 to June 2011), EMBASE, PubMed, and Cochrane databases were searched using the following terms: *dermoscopy, dermatoscopy, epiluminescence microscopy, family practice, general practice, primary health care, melanoma, skin neoplasms,* and *pigmented nevus*. To be included, studies had to be primary research articles with family physicians as the subjects and dermoscopy training and use as the intervention. Four papers met all inclusion criteria and provided level I evidence according to the Canadian Task Force on Preventive Health Care definition.

Main message Among family physicians, dermoscopy has higher sensitivity for melanoma detection than naked-eye examination with generally no decrease in specificity. Dermoscopy also helps to increase family physicians' confidence in their preliminary diagnosis of lesions. When using dermoscopy, compared with naked-eye examination, there is a higher likelihood that a lesion assessed as being malignant is in fact malignant and that a lesion assessed as being benign is in fact benign.

Conclusion Dermoscopy has been shown to be a useful and fairly inexpensive tool for melanoma detection in family practice. This technique can increase family physicians' confidence in their referral accuracy to dermatologists and can assist in decreasing unnecessary biopsies. Dermoscopy might be especially useful in examining patients at high risk of melanoma, as the current Canadian clinical practice guideline recommends yearly screening in these individuals.

The incidence of malignant melanoma in Canada has increased substantially over the past several decades, especially for men.[1] In 2010, melanoma was estimated to rank seventh in cancer incidence in men and eighth in women.[2] Approximately 3% (5200) of all new cancer cases and 1.2% (920) of cancer deaths were due to melanoma. Early detection and excision of the lesion is the most effective treatment to prevent metastatic disease and to increase survival.[3] Breslow thickness, which is a measure of tumour thickness and depth of invasion, is one of the most important prognostic factors for mortality: the earlier the lesion is detected, the higher the chance of survival.[4]

Currently among family physicians naked-eye examination using the ABCDE criteria is widely used: the physician looks at the simple morphologic appearance of the lesion, assessing for asymmetry, border irregularity, colour variegation, diameter greater than 6 mm, and evolution in appearance,[5] although the evolution (E) criterion is not always included in the assessment. Sensitivity and specificity vary depending on how many of the features are present. Sensitivity and specificity have been shown to range from 43% and 99.6%, respectively, with all 5 criteria present, to 97.3% and 36%, respectively, when 1 criterion is present.[6] The group of physicians that originally developed these criteria did so for the purpose of helping nondermatologists to differentiate between common nevi and melanomas; they were not intended for the detection of all malignant lesions.[6]

Another clinical approach that is increasing in popularity is termed the "ugly duckling sign." It is based on the premise that nevi on an individual's skin tend to resemble one another, and that the malignant lesion is identifiable because it differs from its neighbours.[6,7] Scope et

KEY POINTS Dermoscopy is a helpful and inexpensive tool that can be used in daily family practice. Family physicians can use dermoscopic algorithms comfortably after a short training program. Dermoscopy improves family physicians' diagnostic accuracy and confidence in identifying malignant lesions. This technique can help to decrease biopsy rates of benign lesions and unnecessary referrals to dermatologists.

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al[8] demonstrated that the ugly duckling sign is at least 85% sensitive, even when used by nondermatologists.

Research has shown that the accuracy of detecting melanoma is proportional to the number of malignant lesions seen in everyday practice.[9] Thus, this poses a problem: family doctors are expected to detect the abnormal lesions as the first-line physicians, but they see many fewer malignant lesions daily than dermatologists do. What if they are missing some melanomas? The overlap in features between malignant melanomas and benign nevi is the basis of the dilemma in melanoma detection. Is there a better way to detect melanomas and to reduce the number of unnecessary biopsies?[6,10] One technique being used by dermatologists to address this problem since the 1990s is dermoscopy.

What is dermoscopy?

Dermoscopy (also *dermatoscopy, surface microscopy,* or *oil epiluminescence microscopy*) is a technique that involves using a hand-held light magnifier (usually 10-fold magnification) to visualize a skin lesion in depth.[6,11] The early magnifiers required the use of oil or alcohol applied to the lesion in order to decrease light reflection, refraction, and diffraction, and to make the epidermis appear translucent. This enabled the viewer to detect structures and details below the epidermis that could not be seen by the naked eye. The new magnifiers are designed using cross-polarized light filters thus replacing the need for oil or alcohol to be applied to the skin surface. After the physician examines a suspicious lesion with his or her naked-eye, the dermatoscope is then used to obtain a closer, detailed look. The cost of a dermatoscope can range from a few hundred dollars to more than a thousand dollars depending on the manufacturer and model.

A recent meta-analysis of studies done primarily with dermatologists in a clinical setting compared the diagnostic accuracy of naked-eye examination with that of dermoscopy. Results revealed a sensitivity (percentage of melanomas correctly diagnosed) of 71% in naked-eye examination and 90% using dermoscopy.[12] There was no decrease in specificity, suggesting that dermoscopy improved diagnostic accuracy without increasing the number of misdiagnosed nonmelanomas.

One way to determine if dermoscopy is applicable to clinical practice is to assess excision rates of suspicious lesions using naked-eye examination alone compared with naked-eye examination in combination with dermoscopy.[13] A randomized trial of dermatologists trained in dermoscopy revealed a 42% reduction in the number of unnecessary biopsies compared with using the naked eye alone.[14] This is similar to the findings of a retrospective study of pigmented lesion excisions over a period of time before and after dermoscopy use was implemented among dermatologists; the benign-to-malignant ratio significantly decreased from 18:1 to 4.3:1 ($P=.04$).[15] The benign-to-malignant ratio for physicians who did not use dermoscopy did not change significantly (12:1 to 14:1). Thus, the research shows that dermoscopy improves the detection rate of melanoma in addition to decreasing the number of unnecessary biopsies.

However, the effectiveness of dermoscopy depends on formal training and experience with the device.[16] Studies have shown that dermatologists with formal training and at least 3 years of experience in dermoscopy have higher melanoma detection rates compared with untrained dermatologists.[17]

Dermoscopic algorithms

When using a dermatoscope, it is important to have an algorithm with which to analyze the lesion to help differentiate between malignant and benign nevi. The 4 most common algorithms are pattern analysis, the ABCD rules, the 7-point checklist, and the Menzies method.[18,19] A consensus meeting among dermatologists determined that pattern analysis had the highest sensitivity, specificity, and diagnostic accuracy for detecting malignant melanoma versus benign lesions.[20] A simplified 3-point checklist algorithm has recently been developed that showed high sensitivity and reproducibility when used by newly trained dermoscopy users.[21]

Applicability to family practice

Dermoscopy has been shown to be a beneficial tool in clinical dermatology practice. However, can dermoscopy help family doctors improve their diagnostic accuracy when examining pigmented lesions? Is dermoscopy a suitable technique to be used in family practice? This review aims to answer these 2 important questions.

Quality of evidence

Ovid MEDLINE (1946 to June 2011), EMBASE, PubMed, and Cochrane databases were searched using the following terms: *dermoscopy, dermatoscopy, epiluminescence microscopy, family practice, general practice, primary health care, melanoma, skin neoplasms,* and *pigmented nevus.* Studies were included if they were primary research articles with family physicians as the subjects and dermoscopy training and use as the intervention. Articles assessing the use of dermoscopy among dermatologists were not included.

Main message

Study characteristics. The main characteristics of the studies are presented in **Table 1**.[22-25] A total of 4 studies met all criteria. Two of the papers were randomized controlled trials (RCTs). In the study by Argenziano et al,[22] primary care physicians were trained in dermoscopy and were then randomly assigned to examine skin lesions

with either the naked eye alone or the naked eye in combination with dermoscopy. In the study by Westerhoff et al,[23] family physicians were assigned to either a surface microscopy education intervention or a control group. Menzies et al[24] studied a sequential intervention trial using within-lesion controls, allowing for paired analysis. In this study, all family physicians were trained in dermoscopy. Afterward, the physicians examined patients' skin lesions with the naked eye only and recorded a preliminary diagnosis and management plan (biopsy or referral). The physicians then performed dermoscopy on the same lesions and recorded a subsequent diagnosis and management plan. Dolianitis et al[25] used a within-subjects design using counterbalance. Participants were required to learn written and computer-based educational materials on melanoma and 4 different dermoscopy algorithms. They were then shown macroscopic images and asked to identify the melanomas and nonmelanomas. Subsequently, participants were randomly assigned to assess dermoscopic images of the same lesions using the 4 different algorithms in different orders.

In the studies by Argenziano et al[22] and Menzies et al,[24] physicians in the intervention groups were trained to use a hand-held dermatoscope, which simulates real clinical practice. However, in the studies by Westerhoff et al[23] and Dolianitis et al,[25] physicians were trained to use a dermoscopy algorithm while examining magnified photographs of pigmented lesions and did not learn to use the hand-held dermatoscope. This might not be as generalizable to clinical practice but it is still valuable training.

The studies used different dermoscopy algorithms: the 3-point checklist was used in the paper by Argenziano et al,[22] and the Menzies method[26] was used in the papers by Westerhoff et al[23] and Menzies et al.[24] Dolianitis et al[25] used the 7-point checklist, the Menzies method, the ABCD rules, and pattern analysis. The 2 clinical studies used referral to dermatology experts in addition to excisional biopsies as the criterion standard for lesion diagnosis.[22,24] The Westerhoff et al[23] study confirmed the lesion diagnoses with excisional biopsy and histopathologic diagnosis. The study by Dolianitis et al[25] used images of known melanomas and nonmelanomas from one of the author's photograph collections.

In 3 of the studies, the participants were family physicians with no previous training in dermoscopy.[22-24] The study by Dolianitis et al[25] used 61 medical practitioners, all of whom were assessed to be non-experts in dermoscopy and 35 of whom (57%) were general practitioners.

The 2 RCTs qualify as level I evidence; they were well executed, using random assignment of participants. Blinding was not feasible as physicians used either naked-eye or dermoscopy to assess the lesions.[22,23] The paper by Dolianitis et al,[25] although not an RCT, randomly allocated participants to 1 of 4 groups. Using a within-subjects design and counterbalance technique, each group assessed the same test set of images using 1 dermoscopic algorithm at a time, but in differing orders. In addition, the images were in different random order in each test set. In all papers, any physician dropouts were reported and occurred before randomization. The sequential intervention trial by Menzies et

Table 1. Study characteristics

PAPER	STUDY TYPE	PHYSICIAN BACKGROUND	SOURCE OF LESIONS	NAKED-EYE CRITERIA	DERMOSCOPY ALGORITHM	REFERENCE TEST
Argenziano et al[22]	RCT	Primary care physicians, dermoscopy nonusers	Patients in clinic examined by dermatoscope	ABCD rule for melanoma and clinical criteria for BCC and SCC	3-point checklist	Evaluated by dermoscopy experts, biopsies of suspicious lesions
Westerhoff et al[23]	RCT	Primary care physicians, dermoscopy nonusers	Clinical photographs and surface microscopic photographs at ×10 magnification using oil	Not specified	Menzies method	Lesions histopathologically diagnosed
Menzies et al[24]	Sequential intervention trial of within-lesion controls	Primary care physicians, dermoscopy nonusers	Patients in clinic examined by dermatoscope	Not specified	Menzies method	Evaluated by dermoscopy experts, biopsies of suspicious lesions
Dolianitis et al[25]	Within-subjects design using counterbalance technique	Most were primary care physicians (35/61), all dermoscopy nonusers	Clinical macroscopic photographs and dermoscopic images at ×10 magnification	Not specified	7-point checklist; Menzies method; ABCD rule; pattern analysis	Images from a photograph bank of melanoma and nonmelanoma lesions

BCC—basal cell carcinoma, RCT—randomized controlled trial, SCC—squamous cell carcinoma.

al,[24] although using a weaker methodology, demonstrates findings similar to the papers using random assignment. In addition, dropouts were again reported and occurred before the physicians examined any lesions. According to the Canadian Task Force on Preventive Health Care, the recommendations from these papers constitute level I evidence supporting the use of dermoscopy in family practice.

Comparative test performance. The main results of all studies are presented in **Table 2**.[22-25] In both studies in the clinical setting, all malignant tumours (melanoma, squamous cell carcinoma, and basal cell carcinoma) were included in the analysis, with a separate breakdown of melanoma only in 1 study.[22,24] In the papers using images, melanoma and nonmelanoma pigmented lesions were differentiated in the analysis.[23,25] Melanoma prevalence ranged from 0.5% and 9% in the clinical studies to 50% in the image-based studies (**Table 3**).[22-25] All papers reported a median Breslow thickness of 0.5 to 0.6 mm (or *in situ melanoma*).[22-25]

Sensitivity for naked-eye examination (melanoma alone or all malignant lesions) ranged from 37.5% to 60.9% compared with 53.1% to 84.6% for dermoscopy. Argenziano et al[22] demonstrated a significantly higher sensitivity for detecting malignant lesions in the dermoscopy arm compared with the naked-eye examination arm (79.2% vs 54.1%, $P=.002$). Similarly, Westerhoff et al[23] demonstrated that after skin surface microscopy training, there was a significant improvement in melanoma diagnosis using surface microscopy photographs versus clinical photographs (75.9% vs 62.7%, $P<.001$). No significant improvement was seen in the control group (54.8% vs 53.7%, $P=.59$). Dolianitis et al[25] demonstrated higher sensitivity for melanoma detection using any of the 4 diagnostic algorithms compared with clinical examination, with the Menzies method performing the best (84.6% vs 60.9%, $P<.001$). Menzies et al[24] found a non-significant improvement in the sensitivity of dermoscopic examination compared with naked-eye examination for all malignant lesions (5% vs 40%, $P=.179$) and for melanoma alone (53.1% vs 37.5%; $P=.295$). Further, the sensitivity for detection of all malignant lesions and for detection of melanoma significantly increased for dermoscopy compared with naked-eye examination when the physician had the added option of using sequential digital dermoscopic imaging to capture a photograph of the lesion (67.5% vs 40.0%, $P=.014$; and 71.9% vs 37.5%, $P=.006$). Importantly, there was also a significant improvement in the confidence of physicians' diagnoses of true melanoma using dermoscopy compared with naked-eye examination (17% increase; 5.8 vs 6.8, $P=.002$).

Specificity ranged from 71.3% to 85.4% in naked-eye examination compared with 71.8% to 89.0% for dermoscopy, with no significant differences found in 3 of the studies.[22-24] This suggests that physicians correctly identified benign lesions when using dermoscopy and microscopic images as a new tool. Further, Menzies et al[24] found a significant improvement in the physicians' confidence in the diagnosis of true nonmelanoma using

Table 3. Types of lesions assessed

STUDY	TOTAL NO. OF LESIONS	ALL MALIGNANT, N (%)	MELANOMA, N (%)
Argenziano et al[22]	2536	92 (3.6)	12 (0.5)
Westerhoff et al[23]	100	53 (53.0)	50 (50.0)
Menzies et al[24]	374	42 (11.2)	34 (9.1)
Dolianitis et al[25]	40	20 (50.0)	20 (50.0)

Table 2. Main statistical results of all studies: *Boldface indicates a significant difference (P <.05).*

		SENSITIVITY, %		SPECIFICITY, %		POSITIVE PREDICTIVE VALUE, %		NEGATIVE PREDICTIVE VALUE, %	
STUDY	LESIONS	NAKED EYE	DERMOSCOPY	NAKED EYE	DERMOSCOPY	NAKED EYE	DERMOSCOPY	NAKED EYE	DERMOSCOPY
Argenziano et al[22]	All malignant	**54.1**	**79.2**	71.3	71.8	11.3	16.1	**95.8**	**98.1**
Westerhoff et al[23]	Melanoma only	**54.6**	**75.9**	NA	NA	NA	NA	NA	NA
Menzies et al[24]	All malignant	40.0	55.0	84.6	89.0	25.8	40.0	91.3	93.7
	Melanoma only	37.5	53.1	84.6	89.0	20.7	34.0	92.7	94.7
Dolianitis et al[25]	Melanoma only								
	• Menzies method	**60.9**	**84.6**	**85.4**	**77.7**	NA	NA	NA	NA
	• 7-point checklist	**60.9**	**81.4**	**85.4**	**73.0**	NA	NA	NA	NA
	• ABCD rule	**60.9**	**77.5**	**85.4**	**80.4**	NA	NA	NA	NA
	• Pattern analysis	**60.9**	**68.4**	85.4	85.3	NA	NA	NA	NA

NA—not applicable.

dermoscopy compared with naked-eye examination (16% increase; 6.3 vs 7.3, $P<.001$). However, in the study by Dolianitis et al[25] only the specificity for pattern analysis was not significantly different from clinical examination (85.3 vs 85.4, $P=.97$). Unlike the other 3 studies, the specificity of naked-eye examination was found to be significantly higher than the specificity of the other 3 dermoscopic algorithms. It is possible that because the participants in the study by Dolianitis et al[25] were not only family physicians but also included dermatologists and dermatology trainees who were not dermoscopy users, the results might be skewed in that these medical practitioners are better trained at detecting nonmelanomas with the naked eye.

Only the study by Argenziano et al[22] reported a significant difference in negative predictive value (NPV) between the dermoscopy group (98.1%) and the naked-eye group (95.8%) ($P=.004$); this suggests that there is a low likelihood that family physicians would choose to not refer a patient with a suspicious lesion to a dermatologist. In the study by Menzies et al,[24] there was a non-significant improvement in NPV between naked-eye examination and dermoscopy for all malignant lesions (91.3% vs 93.7%, $P=.209$) and for melanoma (92.7% vs 94.7%, $P=.336$).

Positive predictive value and NPV depend on the prevalence of a disease. Therefore, likelihood ratios (LRs) are a more useful measure, as prevalence of melanoma in the general population differs from prevalence in the studies. Positive LRs were only presented in the paper by Dolianitis et al,[25] but they could be calculated with the available data in the studies by Argenziano et al[22] and Menzies et al.[24] The paper by Westerhoff et al[23] did not provide the necessary data for these calculations. For positive LRs, compared with naked-eye examination, dermoscopy was found to be between 12% and 98% better at identifying a skin lesion as malignant, when taking into account only the pattern analysis algorithm in the paper by Dolianitis et al.[25] Negative LRs were calculated from the available data presented in the 3 studies.[22,24,25] The negative LR calculation revealed that compared with naked-eye examination, dermoscopy was 20% to 57% better at identifying a skin lesion as benign (**Table 4**).[22,24,25]

As previously mentioned, an important measure of the utility of dermoscopy is the effect on unnecessary lesion excision rates. Menzies et al[24] reported that there was a significant improvement in the benign pigmented lesion–to-melanoma ratio of excised or referred lesions using dermoscopy versus naked-eye examination (3.7:1 vs 9.5:1, $P=.001$). This suggests that dermoscopy is a useful tool in clinical practice. Of note, Argenziano et al[22] found that 23 malignant tumours were not identified by naked-eye examination but only 6 were missed using dermoscopy ($P=.002$).

Discussion

Research has shown that dermatologists perform better using pattern analysis.[20] However, which dermoscopy algorithm would be best for family physicians to use? Although the paper by Dolianitis et al[25] suggested that pattern analysis had the highest specificity among non-experts, they concluded that the Menzies method had the highest diagnostic accuracy (81.1%) and sensitivity (84.6%), and was preferred most by participants. This was similar to 2 of the other papers discussed.[23,24] Perhaps the new 3-point checklist, which was shown to be effective in the paper by Argenziano et al,[22] could be another useful choice.

The reviewed studies indicate that even a 1-day dermoscopy course, with supplemental reference materials provided, can help to improve physicians' diagnostic skills. Interestingly, the dermoscopy training program in 1 paper significantly increased the sensitivity of naked-eye clinical examination as well.[23]

How sustainable are dermoscopic skills after training? The study by Argenziano et al[22] continued for 16 months and successfully demonstrated that dermoscopy was effective at least this long after training. As long as physicians are using dermoscopy, this will help to keep up their skills.

What are the potential disadvantages? As previously mentioned, there is a cost for the device, ranging from a few hundred dollars for a simple dermatoscope to more than a thousand dollars for the more advanced devices, depending on the manufacturer and model. However, this is relatively inexpensive and could be considered just another necessary tool in the office, like an otoscope or fundoscope.[27]

Another foreseeable drawback is that in order to learn this new skill set, a family physician must dedicate time to training. However, there are a number of ways to learn dermoscopy techniques—through self-teaching with an introductory or comprehensive dermoscopy textbook,[27] or perhaps through a continuing medical education workshop. Family medicine residents could be taught during an academic day or in procedure clinics.

An additional concern for some physicians might be that at first they would require more time to examine patients with the dermatoscope. Nonetheless, like any other new skill, the physician will become more proficient with time. The increase in confidence and improvement in diagnostic accuracy that comes with the use of dermoscopy will very likely outweigh all of these drawbacks.

Conclusion

Dermoscopy has been shown to be a useful and fairly inexpensive tool for melanoma detection in family practice. Among family physicians, dermoscopy has higher sensitivity for melanoma detection than naked-eye examination with generally no decrease in specificity. Further,

Table 4. Calculated LRs and percentage difference between techniques

		POSITIVE LR			NEGATIVE LR		
STUDY	LESIONS	NAKED EYE	DERMOSCOPY	DIFFERENCE, %	NAKED EYE	DERMOSCOPY	DIFFERENCE, %
Argenziano et al[22]	All malignant	1.89	2.81	49	0.64	0.29	55
Menzies et al[24]	All malignant	2.60	5.00	92	0.71	0.51	28
	Melanoma only	2.44	4.83	98	0.74	0.53	28
Dolianitis et al[25]	Melanoma only	4.20			0.46		
	• Menzies method		3.80	- 10		0.20	57
	• 7-point checklist		3.00	- 29		0.25	46
	• ABCD rule		4.00	- 5		0.28	39
	• Pattern analysis		4.70	12		0.37	20

LR—likelihood ratio.

when using dermoscopy, compared with naked-eye examination, there is a higher likelihood that a lesion assessed as being malignant is in fact malignant and that a lesion assessed as being benign is in fact benign.

The current Canadian clinical practice guideline released by Cancer Care Ontario recommends yearly skin cancer screening for individuals at high risk of melanoma.[28] Dermoscopy training and use could be especially helpful for assessing these individuals. This technique can increase family physicians' confidence in their referral accuracy to dermatologists, and can assist in decreasing unnecessary biopsies. The training might even help to increase family doctors' ability to assess lesions using naked-eye examination. Moreover, because a substantial proportion of family medicine involves dermatology, this could be a welcome addition to daily practice.

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Competing interests
None declared

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References

1. Public Health Agency of Canada. *Melanoma skin cancer facts and figures*. Ottawa, ON: Public Health Agency of Canada; 2009. Available from: **www.publichealth.gc.ca**. Accessed 2012 May 9.
2. Canadian Cancer Society. *Canadian Cancer Statistics 2010: special topic end of life care*. Toronto, ON: Canadian Cancer Society; 2010. Available from: **www.cancer.ca**. Accessed 2012 May 9.
3. Brochez L, Verhaeghe E, Bleyen L, Naeyaert JM. Diagnostic ability of general practitioners and dermatologists in discriminating pigmented skin lesions. *J Am Acad Dermatol* 2001;44(6):979-86.
4. Thörn M, Pontén F, Bergström R, Sparén P, Adami HO. Clinical and histopathologic predictors of survival in patients with malignant melanoma: a population-based study in Sweden. *J Natl Cancer Inst* 1994;86(10):761-9.
5. Rigel DS, Russak J, Friedman R. The evolution of melanoma diagnosis: 25 years beyond the ABCDs. *CA Cancer J Clin* 2010;60(5):301-16. Epub 2010 Jun 29.
6. Thomas L, Tranchand T, Berard F, Secchi T, Colin C, Moulin G. Semiological value of ABCDE criteria in the diagnosis of cutaneous pigmented tumors. *Dermatology* 1998;197(1):11-7.
7. Grob JJ, Bonerandi JJ. The "ugly duckling" sign: identification of the common characteristics of nevi in an individual as the basis for melanoma screening. *Arch Dermatol* 1998;134(1):103-4.
8. Scope A, Dusza SW, Halpern AC, Rabinovitz H, Braun RP, Zalaudek I, et al. The "ugly duckling" sign: agreement between observers. *Arch Dermatol* 2008;144(1):58-64.
9. Brochez L, Verhaeghe E, Bleyen L, Naeyaert JM. Diagnostic ability of general practitioners and dermatologists in discriminating pigmented skin lesions. *J Am Acad Dermatol* 2001;44(6):979-86.
10. Salopek TG, Kopf A, Stefanato C, Vossaert K, Silverman M, Yadav S. Differentiation of atypical moles (dysplastic nevi) from early melanomas by dermoscopy. *Dermatol Clin* 2001;19(2):337-45.
11. Menzies SW. Cutaneous melanoma: making a clinical diagnosis, present and future. *Dermatol Ther* 2006;19(1):32-9.
12. Vestergaard ME, Macaskill P, Holt PE, Menzies SW. Dermoscopy compared with naked eye examination for the diagnosis of primary melanoma: a meta-analysis of studies performed in a clinical setting. *Br J Dermatol* 2008;159(3):669-76. Epub 2008 Jul 4.
13. Menzies SW, Salaudek I. Why perform dermoscopy? The evidence for its role in the routine management of pigmented skin lesions. *Arch Dermatol* 2006;142(9):1211-2.
14. Carli P, de Giorgi V, Chiarugi A, Nardini P, Weinstock MA, Crocetti E, et al. Addition of dermoscopy to conventional naked-eye examination in melanoma screening: a randomized study. *J Am Acad Dermatol* 2004;50(5):683-9.
15. Carli P, de Giorgi V, Crocetti E, Mannone F, Massi D, Chiarugi A, et al. Improvement of malignant/benign ratio in excised melanocytic lesions in the 'dermoscopy era': a retrospective study 1997-2001. *Br J Dermatol* 2004;150(4):687-92.
16. Piccolo D, Ferrari A, Peris K, Diadone R, Ruggeri B, Chimenti S. Dermoscopic diagnosis by a trained clinician vs a clinician with minimal dermoscopy training vs computer-aided diagnosis of 341 pigmented skin lesions: a comparative study. *Br J Dermatol* 2002;147(3):481-6.
17. Binder M, Schwarz M, Winkler A, Stiener A, Kaider A, Wolff K, et al. Epiluminescence microscopy. A useful tool for the diagnosis of pigmented skin lesions for formally trained dermatologists. *Arch Dermatol* 1995;131(3):286-91.
18. Argenziano G, Fabbrocini G, Carli P, De Giorgi V, Sammarco E, Delfino M. Epiluminescence microscopy for the diagnosis of doubtful melanocytic lesions. Comparison of the ABCD rule of dermatoscopy and a new 7-point checklist based on pattern analysis. *Arch Dermatol* 1998;134(12):1563-70.
19. Pehamberger H, Steiner A, Wolff K. In vivo epiluminescence microscopy of pigmented lesions. I. Pattern analysis of pigmented skin lesions. *J Am Acad Dermatol* 1987;17(4):571-83.
20. Argenziano G, Soyer HP, Chimenti S, Talamini R, Corona R, Sera F, et al. Dermoscopy of pigmented skin lesions: results of a consensus meeting via the Internet. *J Am Acad Dermatol* 2003;48(5):679-93.
21. Soyer HP, Argenziano G, Zalaudek I, Corona R, Sera F, Talamini R, et al. Three-point checklist of dermoscopy. A new screening method for early detection of melanoma. *Dermatology* 2004;208(1):27-31.
22. Argenziano G, Puig S, Zalaudek I, Sera F, Corona R, Alsina M, et al. Dermoscopy improves accuracy of primary care physicians to triage lesions suggestive of skin cancer. *J Clin Oncol* 2006;24(12):1877-82.
23. Westerhoff K, McCarthy WH, Menzies SW. Increase in the sensitivity for melanoma diagnosis by primary care physicians using skin surface microscopy. *Br J Dermatol* 2000;143(5):1016-20.
24. Menzies SW, Emery J, Staples M, Davies S, McAvoy B, Fletcher J, et al. Impact of dermoscopy and short-term sequential digital dermoscopy imaging for the management of pigmented lesions in primary care: a sequential intervention trial. *Br J Dermatol* 2009;161(6):1270-7. Epub 2009 Jun 27.
25. Dolianitis C, Kelly J, Wolfe R, Simpson P. Comparative performance of 4 dermoscopic algorithms by nonexperts for the diagnosis of melanocytic lesions. *Arch Dermatol* 2005;141(8):1008-14.
26. Menzies SW, Crotty KA, Ingvar C, McCarthy WH. *An atlas of surface microscopy of pigmented skin lesions*. Sydney, Australia: McGraw-Hill International Book Co; 1996.
27. Fox GN. Dermoscopy: an invaluable tool for evaluating skin lesions. *Am Fam Physician* 2008;78(6):704, 706.
28. From L, Marrett L, Rosen C, Zwaal C, Johnston M, Bak K. *Screening for skin cancer: a clinical practice guideline.* Toronto, ON: Cancer Care Ontario; 2007.