Practical application of new technologies for melanoma diagnosis

Part I. Noninvasive approaches

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Learning objectives
After completing this learning activity participants should be able to identify new in situ technologies that may facilitate melanoma diagnosis; explain the advantages and disadvantages of each new in situ technology and how it could impact their patient population; and describe how these technologies can be incorporated into their practice, especially in the screening of patients at high risk of melanoma.

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Confirming a diagnosis of cutaneous melanoma requires obtaining a skin biopsy specimen. However, obtaining numerous biopsy specimens—which often happens in patients with increased melanoma risk—is associated with significant cost and morbidity. While some melanomas are easily recognized by the naked eye, many can be difficult to distinguish from nevi, and therefore there is a need and opportunity to develop new technologies that can facilitate clinical examination and melanoma diagnosis. In part I of this 2-part continuing medical education article, we will review the practical applications of emerging technologies for noninvasive melanoma diagnosis, including mobile (smartphone) applications, multispectral imaging (ie, MoleMate and MelaFind), and electrical impedance spectroscopy (Nevisense). (J Am Acad Dermatol 2015;72:929-41.)

Key words: MelaFind; melanoma; mobile app; MoleMate; Nevisense; spectroscopy; teledermatology.

Abbreviations used:

EIS:	electrical impedance spectroscopy
FDA:	US Food and Drug Administration
MSI:	multispectral imaging
SIA:	spectrophotometric intracutaneous analysis
SK:	seborrheic keratosis

OPPORTUNITY TO IMPROVE MELANOMA SCREENING EFFICIENCY

Key points

- **Melanomas may be difficult to distinguish clinically from nevi, particularly in high-risk patients**

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- **Numerous biopsy specimens associated with melanoma screening can be associated with significant costs and patient morbidity**

Making the clinical diagnosis of melanoma can be straightforward when confronted with a lesion that is markedly asymmetric with nonuniform pigmentation, particularly if there is history of recent change in appearance (ie, ABCDE of melanoma[1]) or if the atypical lesion is solitary or looks different from all other lesions (ie, ugly duckling[2]). However, in patients with numerous and clinically atypical nevi, it can be challenging to visually identify the lesion with the greatest histologically atypical features that may represent a new or developing melanoma. The number of nevi needed to remove in order to find 1 melanoma has been used as a measure of melanoma screening efficiency, with nevus to melanoma ratios ranging from 30 for general practitioners[3,4] to 4 to 12 for dermatologists[3,5-8] to 5 to 17 in specialized clinics seeing high-risk patients.[8-11] While lower nevus to melanoma ratios may indicate that fewer unnecessary biopsy specimens are being obtained, the optimal ratio for any practitioner or group of patients is unclear because removing too few nevi will likely be associated with missing some melanomas. On the other hand, unnecessary procedures may add significant cost to the medical system and morbidity for patients in the form of discomfort and scarring.

NONINVASIVE TECHNOLOGIES TO FACILITATE MELANOMA DIAGNOSIS

Key points

- **Noninvasive technologies may facilitate melanoma diagnosis and/or may minimize obtaining biopsy specimens from benign lesions**
- **Applications of new technologies may soon impact dermatology**

Noninvasive methods and technologies may facilitate early melanoma detection (Fig 1). [F1-4/C] Dermoscopy is a useful adjunctive tool that can help identify melanocytic lesions, increase confidence that a lesion may be benign or malignant, and increase diagnostic sensitivity in experienced users.[12] Serial dermoscopic photographs can be used (with devices such as MoleMax II) to observe individual lesions over time to identify potentially suspicious changes (rapid or asymmetric growth),[13-17] and the use of total body photography can increase the specificity of screening by confirming that most nevi are stable and not changing.[9,18-20] In addition to these conventional approaches, a number of noninvasive technologies have been developed that may facilitate a clinical diagnosis of melanoma. Reflectance confocal microscopy allows near-microscopic visualization of structures below the skin surface that approximates the resolution of histologic examination,[21,22] and several studies have shown its potential utility.[23-25] However, the large size and cost ($70,000-100,000) of instruments such as the Vivascope (personal communication with manufacturer, March 2015) will likely limit their current use to research applications, and this modality appears unlikely to make its way into community dermatology practices in the near future. These methods and technologies were reviewed in a continuing medical education article dealing with strategies for clinical management of patients with nevi that was published in the *Journal* in 2009.[26] Since that time, new information has been presented that addresses the applicability and efficacy of other technologies. In addition, Internet-based mobile applications (apps) have been developed for the detection of melanoma. We focus on these newer noninvasive technologies and their respective applications that are currently (or will soon be) commercially available and that may impact the practice of dermatology.

MOBILE (SMARTPHONE) APPLICATIONS

Key points

- **Smartphone-based applications for skin monitoring and melanoma detection are commercially available**
- **Many smartphone-based apps may not be reliable**

The near universal acceptance of the smartphone in developed countries has the potential to impact melanoma screening and early detection. Of 229 dermatology-related apps recently surveyed, 41 (18%) were related to self-surveillance/diagnosis and 8 (3.5%) related to teledermatology; half were free, and the others ranged in price from $0.99 to $139.99.[27] These include apps developed to assist patients in identifying melanoma on their skin. We reviewed apps that have been validated in published studies (Table I). Apps and accessories, including dermoscopes that can be mounted on the iPhone (Apple, Cupertino, CA), are also available to facilitate mobile teledermatology. These advancements in mobile technology could improve the detection rate and efficiency of self-skin examinations, leading to reduced time to diagnosis, mortality, and health care costs associated with melanoma. However, concerns have been expressed regarding the safety and accuracy of these mobile technologies.

In 2011, Health Discovery Corporation launched MelApp for the iPhone. It was one of the first mobile apps to use pattern recognition software and mathematical algorithms to provide melanoma risk