Noninvasive Technologies for the Diagnosis of Cutaneous Melanoma

Richard R. Winkelmann, DO[a,*], Aaron S. Farberg, MD[b], Alex M. Glazer, MD[c], Darrell S. Rigel, MD, MS[d]

KEYWORDS

• Melanoma • Technology • Multispectral analysis • Diagnosis • Medical device • Noninvasive

KEY POINTS

- Multispectral analysis devices assess pigmented lesion disorganization at different levels of the skin using variable wavelengths of light with subsequent computerized analysis.
- Aggregated data investigating the influence of multispectral digital skin lesion analysis on biopsy decisions for melanoma revealed an overall increase in sensitivity from 70% to 88%.
- Five studies using spectrophotometric intracutaneous analysis scope demonstrated an overall sensitivity and specificity of 85% and 81%, respectively, for the detection of melanoma.

INTRODUCTION

Over the past several decades, there have been many advances in the development of noninvasive technologies that facilitate the early detection of cutaneous melanoma. The use of dermoscopy and total body photography are established modalities proven to enhance the clinical evaluation of pigmented skin lesions at the level of the skin surface. Multispectral analysis devices take advantage of the variable penetration depths of isolated wavelengths of light to assess for pigmented lesion disorganization at different levels of the skin from the surface down to the superficial dermis. Pigmented skin lesion morphology is analyzed via computerized algorithms that measure morphologic disorganization using either melanin alone or in conjunction with hemoglobin and collagen as chromophores.

CONTENT

Multispectral digital skin lesion analysis (MSDSLA; MelaFind, STRATA Skin Sciences Inc., Horsham, PA) is a medical device that uses visible and near infrared light (430–950 nm) to image pigmented skin lesions at and up to 2.5 mm below the skin surface.[1] Complex computerized analysis uses 75 unique analytical parameters to measure the degree of melanin disorganization within a pigmented skin lesion at 10 different spectral bandwidths. Originally validated on a set of 1432 pigmented lesions with subsequent logistical regression analysis, MSDSLA provides the clinician with the probability the suspicious pigmented skin lesion is a melanoma, and melanoma, high-grade dysplastic nevus, and atypical melanocytic hyperplasia.[2]

Monheit and colleagues[2] used MSDSLA alone to evaluate 1632 suspicious pigmented lesions

Relevant Conflicts of Interest: Drs R.R. Winkelmann, A.S. Farberg and D.S. Rigel served as a consultant to MelaSciences, Inc. Dr A.M. Glazer has no conflicts.

[a] Department of Dermatology, OhioHealth, 40 West Hubbard Avenue, Columbus, OH 43215, USA; [b] Department of Dermatology, Icahn School of Medicine at Mt. Sinai, 5 East 98th Street, New York, NY 10029, USA; [c] National Society for Cutaneous Medicine, 35 East 35th Street #208, New York, NY 10016, USA; [d] Department of Dermatology, NYU School of Medicine, 35 East 35th Street #208, New York, NY 10016, USA
* Corresponding author.
E-mail address: rrwink@gmail.com

Dermatol Clin ■ (2017) ■–■
http://dx.doi.org/10.1016/j.det.2017.06.006

for biopsy, of which 127 were melanoma. The sensitivity of MSDSLA for the detection of melanoma was 98% with a specificity of 11% in recognizing lower risk lesions. In this primarily university-based study, a low disorganization finding was associated with a 98% negative predictive value. However, the frequency and distribution of pigmented lesions that are encountered at high-risk pigmented lesion clinics would be expected to be different than what is experienced in a community-based setting. A subsequent study evaluating the efficacy of MSDSLA in a community-based setting revealed a negative predictive value of 100%.[3]

The influence of MSDSLA on practitioner decisions to biopsy suspicious pigmented skin lesions has been studied in 7 reader studies including 855 practitioners.[4–10] Participants were shown a subset of 62 clinical (distant and close-up) and dermoscopic images of pigmented skin lesions (13 invasive melanomas, 10 melanomas in situ, 7 high-grade dysplastic nevi, and 32 benign skin lesions including low-grade dysplastic nevi) previously analyzed by MSDSLA. Aggregated data revealed the overall sensitivity for the detection of melanoma or other high-grade pigmented lesion improved from 70% after clinical evaluation to 88% after MSDSLA information was provided ($P<.001$). Participant specificity increased from 52% to 58% ($P<.001$) after MSDSLA and diagnostic accuracy improved from 59% to 69% ($P<.001$) with MSDSLA (**Table 1**).

Spectrophotometric intracutaneous analysis (SIA) scope (SIAscope, Biocompatibles, Farnham, Surrey, UK)[4] was approved by the US Food and Drug Administration in 2011 and also has Health Canada approval and a CE Mark in Europe. The device uses a handheld scanner to measure reflected radiation after exposing the skin to visible and infrared radiation (400–1000 nm). Via computerized algorithms, 8 high-resolution, spectrally filtered color images are analyzed based on total eumelanin, hemoglobin, and collagen content. Studies have found that SIA accurately measures the melanin density across all Fitzpatrick skin types.[5,6]

In an initial study evaluating a set 348 suspicious pigmented skin lesions, SIA had a sensitivity and specificity of 83% and 80%, respectively, for the identification of melanoma.[11] Aggregated data from 5 studies of SIA evaluating suspicious pigmented skin lesions demonstrated an overall sensitivity and specificity of 85% and 81%, respectively, for the detection of 566 melanomas from a total of 4669 pigmented skin lesions (**Table 2**).

Studies evaluating the use of SIA in the community-based setting have not been as favorable.[14] Govindan and colleagues[7] evaluated the accuracy of general practitioners using SIAscope to refer 886 lesions to a pigmented lesions clinic. The presence of only dermal melanin gave 94.4% sensitivity and 64% specificity for melanoma detection. These data were attributed to the lack of training and negative effects seborrheic keratoses have on the performance of the device.

The original algorithm was modified subsequently to help primary care physicians differentiate seborrheic keratoses and hemangiomas from higher risk pigmented lesions. A new scoring system incorporated the presence of collagen white dots, a cerebriform pattern, blood vessels, and the patient's age into the existing Moncrieff scoring system. The new Molemate system

Table 1
Studies reviewed and aggregated showing impact of MSDSLA on melanoma diagnosis

		Sensitivity (%)		Specificity (%)		Biopsy Accuracy (%)	
Study, Year	n[a]	Clinical Evaluation	After MSDSLA	Clinical Evaluation	After MSDSLA	Clinical Evaluation	After MSDSLA
Rigel et al,[9] 2012	179	69	94	43	25	—	—
Yoo et al,[10] 2013	126	52	77	54	40	—	—
Winkelmann et al,[11] 2015	67	67	92	37	57	49	71
Winkelmann et al,[12] 2015	41	64	62	57	73	60	68
Winkelmann et al,[13] 2015	212	65	83	40	76	52	80
Winkelmann et al,[14] 2016	59	59	74	48	56	53	65
Farberg et al,[15] in press	160	76	92	52	79	64	86
Aggregate	855	70	88	52	58	59	69

Abbreviation: MDSLA, multispectral digital skin lesion analysis.
[a] Metaanalysis included all participants in each study including those who did not evaluate the complete set of lesions.