

SPECTROPHOTOMETRIC INTRACUTANEOUS ANALYSIS (SIA) FOR THE DIAGNOSIS OF EARLY MALIGNANT MELANOMA – DERMAL MELANIN DEPTH AND DISTRIBUTION

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Introduction

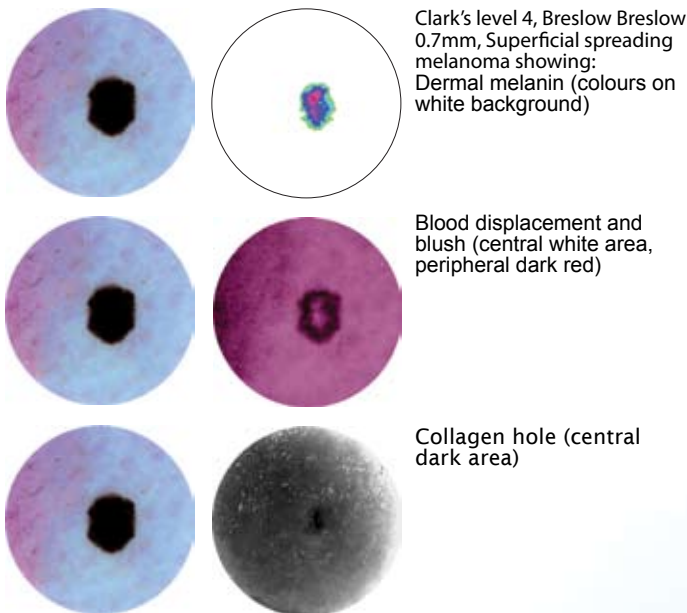
SIAscopy is a multispectral imaging technique that rapidly returns high-resolution information regarding the skin. Simple SIAscopic features for the detection of melanoma have been identified and include: melanin in the papillary dermis, central displacement of papillary blood supply with a peripheral erythematous blush and holes in the papillary collagen¹.

SIAscopy is able to reliably detect melanin in the dermis even when the depth of penetration beneath the dermo-epidermal junction is small (0.01mm). This accuracy led to a high sensitivity of this single feature for the identification of melanoma (96%). However, the specificity is lower (56%) due mainly to compound and dysplastic naevi¹.

It is now possible to determine the depth and distribution of the dermal melanin. From the pathophysiology of pigmented skin lesions melanin within benign lesions should primarily be found in the superficial dermis and be arranged symmetrically in nests. Conversely within melanoma, pigment should be found deeper within the dermis and arranged in a less symmetrically but more contiguous manner².

Methods and Materials

Patients referred by their Consultant Dermatologist or Plastic



Surgeon for excision biopsy of a pigmented skin lesion from our hospital were recruited for this study over a 6 month period and informed consent was obtained. The patients were photographed twice using a digital camera (Canon) with a standard 2X macro lens (Canon) and a dermatoscopy lens (Heine Dermaphot - 10X magnification). The patients were asked questions about the lesion - change in size, shape and colour; change in sensation; bleeding and inflammation - and the maximum diameter was measured in millimetres. This information and standard demographic data (age, sex, hospital number) were recorded and stored in a protected computerised database. SIAscopy was performed using the SIAscope (Astron Clinica, Cambridge, UK) and the returned SIAgraphs were also stored on a database. The system takes approximately 5 seconds to acquire the images and a further 10 seconds to process the data and return it as visual information. Excision biopsy was then performed and the results from histopathological examination by two clinicians - used as reference or gold standard - were obtained and matched with the data.

Definitions of simple features have already been described and shown to have a high degree of reliability and reproducibility. The presence or absence of these features was recorded along with 3 new features - dermal melanin depth, dermal melanin asymmetry and dermal melanin distribution. The definitions of these are presented in table 1.

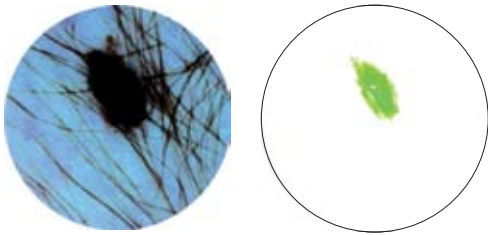
Dermal melanin levels (1-5) are a function of the concentration and depth of melanin in the papillary dermis. When assessing the distribution of dermal melanin it is possible to rotate the image by 360° in all 3 axes.

Statistical analysis was performed on the data set using SPSS for Windows v9.0 (SPSS Inc.) software on a personal computer. Logistic regression analysis was used to produce a receiver-operator curve for combinations of features.

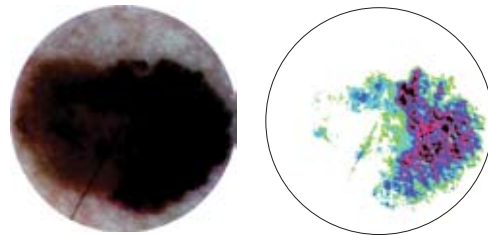
Results

A total of 241 lesions were removed, including 31 melanomas (1 in 7.8 lesions). There were 26 superficial spreading melanomas, 4 in situ melanomas and 1 nodular melanoma. The mean Breslow thickness was 0.84mm and the median Breslow thickness was 0.5mm (range in situ to 4.5mm). A breakdown of the other lesions can be seen in table 2, the vast majority of these being benign naevi. This represents a case-mix that would be expected

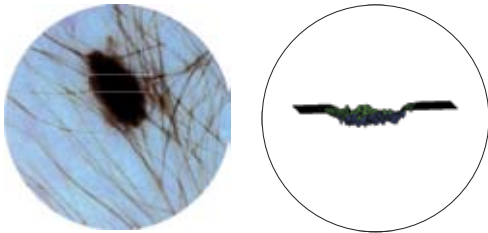
in a pigmented lesion clinic.



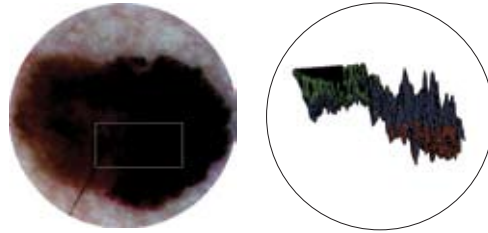
Dysplastic compound naevus
Showing dermal melanin level 2 in a regular, symmetrical distribution, excluding hair artifact



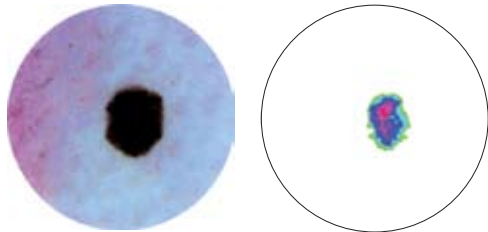
Clark's level 3, 1.4mm thick superficial spreading malignant melanoma showing dermal melanin level 5 in an asymmetric distribution



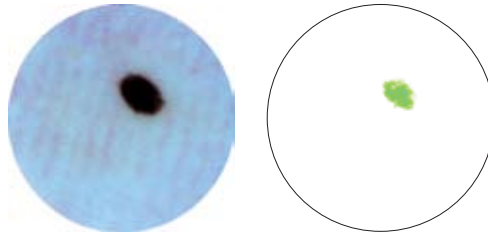
Showing dermal melanin distribution in regular small peaks and troughs



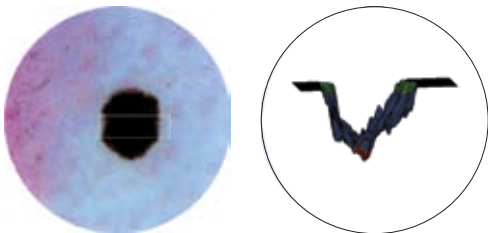
Showing edge of area of dermal involvement



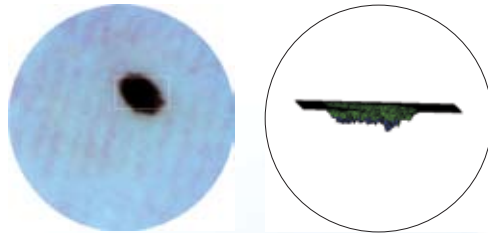
Clark's level 4, 0.7mm thick superficial spreading melanoma showing asymmetric dermal melanin, level 5



Junctional naevus showing dermal melanin level 2 in a symmetrical distribution

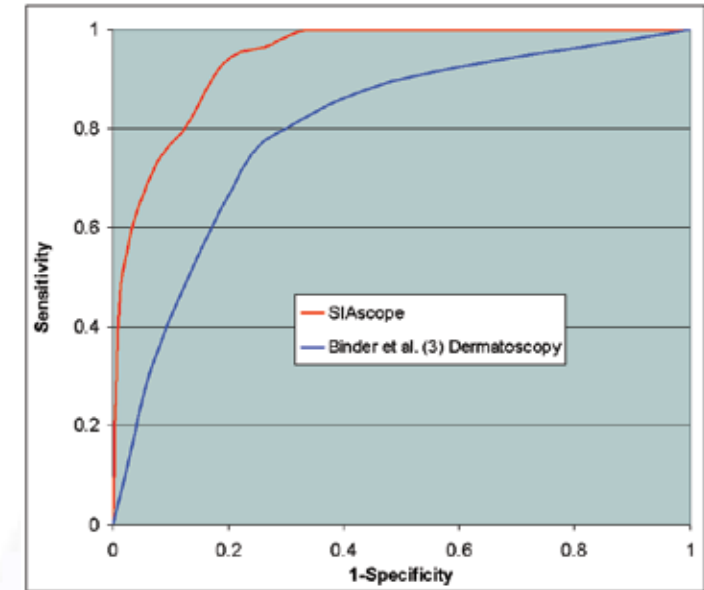


Showing large, irregular area of contiguous dermal melanin.



Showing regular, small peaks and troughs of dermal melanin.

Using logistic regression analysis a receiver-operator (ROC) curve was constructed for combinations of features and clinical data. ROC curves are useful for considering the performance of a diagnostic test. By selecting a certain point on the ROC curve the clinician can see what the false positive rate will be at any given sensitivity. The closer the ROC curve is to the top left hand corner of the graph the better. The area under our curve is 0.94 indicating a test with favourable diagnostic performance in relation to dermoscopy, as is shown on the ROC.



While this analysis has been performed on a training set of lesions, the results indicate that combining the techniques of dermoscopy and SIAscopy could significantly improve diagnostic accuracy in this important area.

References

1. Moncrieff M, Colton S, Claridge E & Hall P. Spectrophotometric intracutaneous analysis - A new technique for imaging pigmented skin lesions. *Br J Derm*, 2002; In Press
2. Mool W & Krausz J. *Biopsy Pathology of Melanocytic Disorders*. Chapman & Hall, London, 1992
3. Binder et al. Epiluminescence microscopy of small pigmented skin lesions: short-term formal training improves the diagnostic performance of dermatologists *J Am Acad Dermatol*, 1997; 36: 197-202

This research is funded by a grant from the Engineering & Physical Sciences Research Council, UK and Astron Clinica, Cambridge, UK