# SPECTROPHOTOMETRIC INTRACUTANEOUS ANALYSIS
# A NEW TOOL FOR THE ASSESSMENT OF PIGMENTED SKIN LESIONS

M. Moncrieff[1], S. Cotton[2], E. Claridge[3] & P. Hall[1]

1. Department of Plastic Surgery, Addenbrooke's Hospital, Cambridge, UK 2.Astron Clinica Limited, Cambridge, UK 3. Department of Computer Science, University of Birmingham, UK

**1.Abstract**

A study of the use of in-vivo macro histological information returned by a SIAscope in the diagnosis of malignant melanoma is presented.

**2. SIA - a New, Rapid Analysis Technique**

Spectrophotometric Intracutaneous Analysis (SIA) is a non-invasive, rapid scanning technique where a SIAscope is used to analyse light reflected from the skin. Complex algorithms return 'SIAgraphs,' high-resolution maps of components of the skin. These include the:

- Location of melanin in the papillary dermis
- Concentration of blood and collagen in the papillary dermis
- Total concentration of melanin in the papillary dermis and epidermis
- Contours of the dermal-epidermal junction
- Concentration of keratin in the epidermis

**3. Assessment of 138 lesions with SIA**

138 lesions referred for biopsy excision were assessed using SIAscopy for a range of features including:

- Presence of dermal melanin in the Dermal Melanin SIAgraph
- Presence of blood displacement with a peripheral erythematous blush within the Blood SIAgraph
- Presence of holes within the collagen of the papillary dermis within the Collagen SIAgraph
- Clumping and aggregations of melanin within the Total Melanin SIAgraph
- Diameter greater than 6mm.

The lesions were then excised and sent for histological diagnosis. The diagnoses of these lesions included 19 invasive and 4 in situ melanomas, 73 common naevi, 2 lentigo malignas and 40 assorted lesions including congenital naevi, seborrheic keratoses, haemangiomata, Spitz naevi and other rarer pigmented lesions. The average Breslow thickness of the invasive melanomas was 1.81mm (8 melanomas less than 0.76mm).

**4. Measuring the Diagnostic Accuracy of SIA**

Logistic regression analysis was performed on the identified features where it was shown that a simple combination of the presence of dermal melanin concurrent with the presence of blood displacement and a peripheral erythematous blush and a diameter of 6mm or more produces the results shown in table 1.

Table 1

| | Melanoma | Non-Melanoma | Total |
|---|---|---|---|
| Test +ve | 21 | 26 | 47 |
| Test ve | 2 | 89 | 91 |
| Total | 23 | 115 | 138 |

The sensitivity of this approach was 91.3% with a specificity of 77.3%. The positive likelihood ratio was 4.02 and the negative likelihood ratio was 0.112. In other words, in the presence of these three signs the patient is four times more likely to have a melanoma. Conversely in the absence of these three signs the patient is nine times less likely to have a melanoma.

**5. Conclusion**

SIA Presents New Information Pertinent to the Diagnosis of Malignant Melanoma

The SIAscope presents new information regarding the in-vivo macro histology of the skin. In this study three easily identifiable and repeatable SIAscopy features were shown to yield a high sensitivity in the diagnosis of malignant melanoma. Further research will produce a more definitive analysis of this technique with the aim of developing an atlas of SIAscopy.

This information can be used to assist in the diagnosis and monitoring of naevi and early malignant melanoma. Further on, this two-year study will identify and assess features obtained using SIA technology and provide specificity and sensitivity to guide the physician in planning the management of their patient.

## Case Study 1 : Thick Melanoma

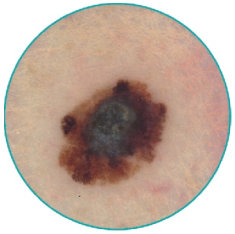


**Figure 1[left]:**
**Dermatoscopy View**
Polarised light view of a superficial spreading melanoma on the leg of a 57 year old male. Breslow thickness 2.5mm with central vertical growth phase nodule. Dermatoscopic features easily identified include blue-grey veil, broadened pigment network and radial streaming.

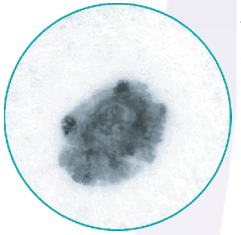
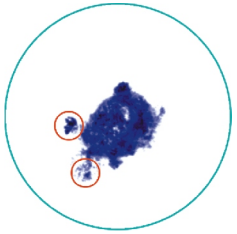


**Figure 1a [left]:**
**Total melanin SIAgraph**
Darker areas denote higher concentration of melanin in the epidermis and papillary dermis. Dermatoscopic features and border detail of the lesion are enhanced in this view.



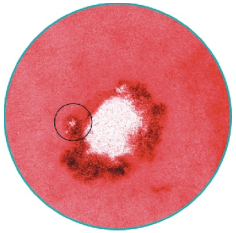


**Figure 1b [left]:**
**Blood SIAgraph**
Darker red denotes higher haemoglobin concentration. The invasive nodule has displaced the blood supply from the papillary dermis. Immunocytic reaction has produced vasodilation, seen as a peripheral 'erythematous blush.'

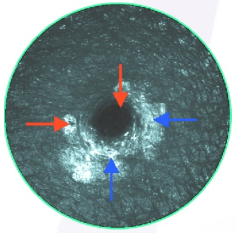


**Figure 1d [left]:**
**Collagen SIAgraph**
White = high collagen concentration. The central invasive nodule has punched a hole in the collagen layer as has the early invasive component peripherally (red arrows). At the periphery, the immunocytic response to the early invasive region has produced fibrosis seen as whorls and rosettes (blue arrows).

**Figure 1c [above]:**
**Dermal Melanin SIAgraph**
The dermal melanin is asymmetrically distributed in large contigious regions. The central region correlates well with the blue-grey veil seen on the polarised light view. Note the early invasion picked up at the periphery (circled).

## Case Study 2 : Thin (early) Melanoma

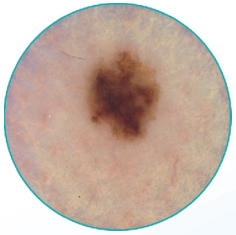


**Figure 2 [left]:**
**Dermatoscopy View**
Polarised light view of a superficial spreading melanoma on the leg of 47 year old female. Breslow thickness 0.4mm, Clark's level II.

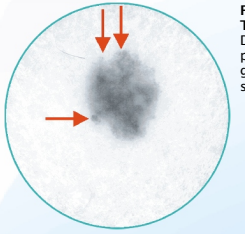
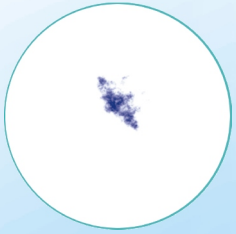


**Figure 2a [left]:**
**Total melanin SIAgraph**
Dermatoscopic features such as pigment network, central globules & peripheral dots are seen (blue arrows).



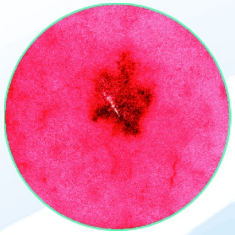


**Figure 2b [left]:**
**Blood SIAgraph**
Central displacement of blood and peripheral erythematous blush.

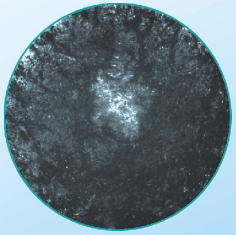


**Figure 2d [left]:**
**Collagen SIAgraph**
Increased collagen is seen centrally, indicating fibrosis. There are no collagen holes seen as this is a Clark's level II melanoma

**Figure 2c [above]:**
**Dermal melanin SIAgraph**
Asymmetric and contigious distribution of dermal melanin relating to areas of blood displacement.

**References:**
Cotton, S, Claridge, E & Hall, P (1999) 'A skin imaging method based on a colour formation model and its application to the diagnosis of pigmented skin lesions,' Proceedings of Medical Image Understanding and Analysis '99 (Hawkes D et al. Eds.) 49-52
Cotton, S, Claridge, E & Hall, P (1997) 'Noninvasive skin imaging,' Duncan J & Gingi, R eds, Springer-Verlag. XVth International Conference on Information Processing in Medical Imaging, Vermont, USA, 1997.

Astron Clinica
United Kingdom: T. +44 (0) 1223 265 000 E. info@astronclinica.com
Australia: T. +61 (7) 3303 8472 E. ozinfo@astronclinica.com

ASTRON CLINICA
THROWING LIGHT ON SKIN HEALTH

*Originally presented at EADV 2000*