A Comparison Between Dermatoscopy and Spectrophotometric Intracutaneous Analysis (SIAscopy) for the Diagnosis of Melanoma

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The incidence of malignant melanoma continues to rise with an overall incidence in the UK in 1995 of 5000 cases per annum (Creagan 1997). Mortality measurements show that this is also still rising although the rate of increase is tailing off (Hall et al 1999). The most effective treatment for malignant melanoma is early diagnosis and surgical excision.

Clinical diagnosis is not always simple with diagnostic accuracy of between 50 and 80% although this may be improved with time and experience (Curley et al 1989, Grin et al 1990, Morton & McKie 1998). In an effort to improve diagnostic skills a number of techniques have been developed. The most widely used of these is dermatoscopy, a technique that uses a hand held microscope with oil-immersion to visualise the internal structure of the lesion at the dermo-epidermal junction. The first methodical approach was described by Pehamberger and colleagues in 1987 and was termed 'pattern analysis'. This takes into account not only the global appearance of the lesion using the dermatoscope but also a stepwise approach to the diagnosis of the lesion by first determining whether the lesion is melanocytic or otherwise and second, if the lesion is melanocytic, whether it is benign or malignant. This has been shown to improve the correct diagnosis of pigmented skin lesions by 10 to 30% (Pehamberger et al 1987). Unfortunately the use of this technique in those not formally trained may lead to a decreased diagnostic ability (Binder et al 1995). An improved diagnosis has been shown after a total of 9 hours formal training (Binder et al 1997). In an effort to improve diagnostic skills amongst non-experts in dermatoscopy a number of new methods have been described including the ABCD rule (Stolz et al 1994), the 7-point checklist (Argenziano et al 1998) and the method described by Menzies (Menzies et al 1996). In a recent Consensus Net Meeting these methods when used by experts have been shown to have similar sensitivity but decreased specificity in comparison with pattern analysis (Argenziano 2001).

A large study involving the new technique of Spectrophotometric Intracutaneous Analysis (SIAscopy) has recently been described (Moncrieff et al 2002). This study demonstrated that SIAscopy is a very useful tool in aiding the clinician to diagnose pigmented skin lesions. SIAscopy is a multispectral imaging technique that allows extraction of information regarding the microarchitecture of the skin. The technique can be rapidly and easily performed in vivo and allows examination of the distribution of chromophores within the skin including melanin, blood and collagen within the papillary dermis and the position of melanin relative to the dermoepidermal junction. The SIAscope operates by probing the skin with radiation ranging from 400 to 1000 nm. Eight narrow-band spectrally filtered images are obtained and used as inputs for complicated computer algorithms that extract information regarding the architecture of the skin.

The wavelengths of the wavebands are chosen to interact preferentially with constituents of the skin (Cotton 1998). SIAgraphs are displayed showing detailed information regarding the total melanin content of the lesion and the melanin, collagen and blood content of the papillary dermis within the lesion and the surrounding skin.

Table 2. SIAscopic scoring system

Feature	Definition	Score
Dermal melanin	The presence of dermal melanin within the lesion not due to hairs	3
Blood displacement with blush	A confluent non -pixelated area demonstrating an absence of blood within the lesion with a peripheral increase in blood for ¾ of the circumference of the lesion	1
Diameter	Maximum diameter >6mm	1
Age	Age in years	1 For every completed 15 years

The score is calculated by simple addition. A total score >5 is indicative of melanoma

Table 3. 7-point checklist (Argenziano et al 1998)

Dermoscopic criteria	Definition	Score
Major criteria		
Atypical pigment network	Black, brown or grey network with irregular meshes and thick lines	2
Blue-whitish veil	Irregular, structureless area of confluent blue pigmentation with an overlying "ground -glass" film. The pigmentation cannot occupy the entire lesion and usually corresponds to a clinically elevated part of the lesion	2
Atypical vascular pattern	Linear irregular or dotted vessels not clearly combined with regression structures	2
Minor criteria		
Irregular streaks	More or less converging, linear structures irregularly distributed at the edge of the lesion and not clearly combined with pigment network lines	1
Irregular dots/globules	Black, brown, round to oval, variously sized structures irregularly distributed within the lesion	1
Irregular blotches	Black, brown, and/o r grey structureless areas asymmetrically distributed within the lesion	1
Regression structures	White scar -like depigmentation and/or blue pepper -like granules usually corresponding to a clinically flat part of the lesion	1

The score is calculated by sim ple addition. A total score 3 is indicative of melanoma

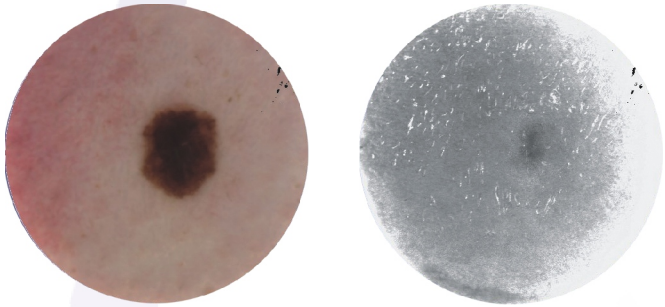

Fig 1. SIAgraph display showing colour view (left) and collagen view (right) of Clark's level III, 1.4mm superficial melanoma. Note the dark collagen hole in the centre of the collagen SIAgraph.

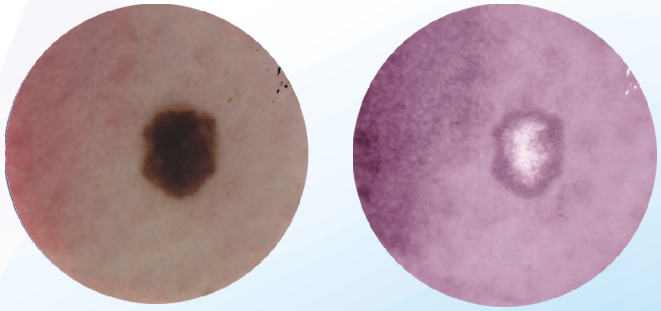

Fig 2. SIAgraph showing blood view of the same melanoma. Note the central displacement of blood (pale pink/white) and the peripheral erythematous blush.

Single features within SIAgraphs have been identified (Figs 1,2&3) and the sensitivity and specificity of these features for the diagnosis of melanoma have been described (Moncrieff et al 2002)(Table 1). These simple features have been shown to be both highly reliable and reproducible in their identification. Furthermore combining SIAscopy features with standard clinical data has made it possible to devise a very simple scoring system based on lesion diameter, patient age, dermal melanin and blood displacement with blush (Moncrieff 2002) that is both highly specific and sensitive in diagnosing melanoma.

In this paper we directly compare this new SIAscopic scoring system with the 7-point checklist rule of dermatoscopy (Argenziano et al 1998) on 150 melanocytic lesions.

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Table 1. Sensitivity and specificity data for SIAscopic features

Feature	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Dermal melanin	96.2 (87-98.9)	56.8 (51.1-62.3)	28.1	98.8
Collagen holes	78.8 (66-87.8)	74.0 (68.7-78.7)	34.7	95.2
Blood displacement	75.0 (57.3-87)	70.3 (63-76.6)	30.7	94.1
Erythematous blush	75.0 (61.8-84.8)	65.5 (60-70.7)	27.7	93.7
Blood displacement with blush	63.5 (49.9-75.2)	84.8 (80.3-88.4)	42.3	93

Sensitivity = true positive/(true positive + false negative); specificity = true negative/(true negative + false positive); positive predictive value (PPV) = true positive/(true positive + false positive); negative predictive value (NPV) = true negative/(true negative + false negative). Values in parentheses are 95% confidence intervals

Materials and Methods

This study was designed to assess the ability of the SIAscope and a simple scoring system at detecting malignant melanoma and to compare this directly with the 7-point checklist described by Argenziano. Patients referred for excision biopsy of a pigmented skin lesion either from the plastic surgery or dermatology departments of Addenbrooke's Hospital were recruited over a period of 5 months and informed consent was obtained. The patients pigmented lesions were photographed twice using a conventional digital camera (Canon DS30); once with a standard x2 macro lens (Canon) and once using a dermatoscopy lens (Heine Dermaphot: x10 magnification). Patients were asked questions about the lesion – change in size, shape and colour; change in sensation; bleeding and inflammation – and the maximum diameter of the lesion was measured in millimetres. This information and standard demographic data 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 protected computer database. The SIAgraphs were analysed on a 19-inch monitor using exactly the same software employed by the SIAscope (Astron Clinica, Cambridge, UK). Excision biopsy was then performed and the results from histopathological examination (used as the reference or gold standard) were obtained and matched with the data. Two senior clinicians, one of whom specialises in dermatopathology, made the histopathological diagnosis of melanoma.

One of the authors (JP) analysed the SIAgraphs and calculated the scores using the system presented in Table 2. Another author (MM), with experience and formal training in dermatoscopy, analysed the dermaphot dermatoscopy images and scored them according to the 7-point checklist described in Table 3. Both experimenters were blinded as to the histopathological diagnosis of melanoma.

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Results

A total of 214 lesions were removed. 26 melanomas were removed with a mean and median Breslow thickness of 0.73mm and 0.5mm respectively. Of the melanomas 4 were in situ and 19 had a Breslow thickness £ 1.0mm (range in situ to 2.8mm). There were a total of 176 melanocytic lesions, 150 of which had suitable digital images and SIAgraphs for analysis. The diagnoses of these are presented in table 4. The majority of the 26 lesions that did not have suitable images were in anatomical areas where it was not possible to place the probe of the SIAscope/dermaphot flat and therefore produce clear images (e.g. near or under a nail, nasolabial area).

The results for each test including sensitivity and specificity data for each test are presented in table 5. It can be seen that neither test failed to identify a malignant melanoma (sensitivity of 100%). The specificity of the SIAscopic scoring system was higher than the dermatoscopic method

Table 4. Histopathological diagnosis of lesions examined

Diagnosis	Number of lesions
Malignant melanoma	26
Dysplastic naevus	8
Compound naevus	81
Junctional naevus	13
Intradermal naevus	17
Blue naevus	3
Spitz naevus	2
Total	**150**

The proportion of lesions examined represents that which would be exp ected in an average pigmented lesion clinic

Table 5. Sensitivity and specificity results

	7-point checklist	SIAscopic score
True positive (TP)	26	26
False positive (FP)	35	27
True negative (TN)	89	97
False negative (FN)	0	0
Sensitivity (%)	100 (87.1-100)	100 (87.1-100)
Specificity (%)	71.8 (63.3-78.9)	78.2 (70.2-84.6)
PPV (%)	42.6 (31-55.1)	49.0 (36.1-62.20
NPV (%)	100 (95.9-100)	100 (96.3-100)

Sensitivity = TP/(TP + FN); specificity = TN/(TN + FP); positive predictive value (PPV) = TP/(TP + FP); negative predictive value (NPV) = TN/(TN + FN). Values in parentheses are 95% confidence intervals

(78.2% vs 71.8%) although not significantly different as their 95% confidence intervals overlap. The majority of the false positive results were due to compound melanocytic naevi (7-point checklist 24/35, SIAscopic score 13/27). Of the 8 dysplastic naevi in the dataset 2 were incorrectly identified as melanoma using the 7-point checklist and 4 using the SIAscopic scoring method.

Discussion

The use of dermatoscopy as an aid to diagnosis for pigmented skin lesions is well established. However its use in those not formally trained can lead to a decrease in performance (Binder et al 1995). A number of scoring systems have been described to aid the non-expert in dermatoscopy (Argenziano et al 1998, Stolz et al 1994, Menzies et al 1996), one of which we have tested against our new technique of SIAscopy. The aim of this study was to show that this new and simple system was at least as good as those methods presently available.

Both tests performed well and the 7-point checklist achieved a sensitivity and specificity comparable to that originally described by Argenziano. Neither test failed to correctly diagnose a malignant melanoma. The new SIAscopic score performed as well as the 7-point checklist but was easier to apply.

To assess a pigmented lesion using the SIAscopic method the user was required to make only 2 decisions , namely the presence of dermal melanin and the presence of blood displacement with erythematous blush. These two features have been shown to be highly reliable and reproducible (Moncrieff et al 2002) and the assessment of dermal melanin has been shown to be easily performed by nursing staff with minimal formal training (Wardle T 2002). In contrast the 7-point checklist requires the user to search for 7 specific criteria. The decision making process is complicated

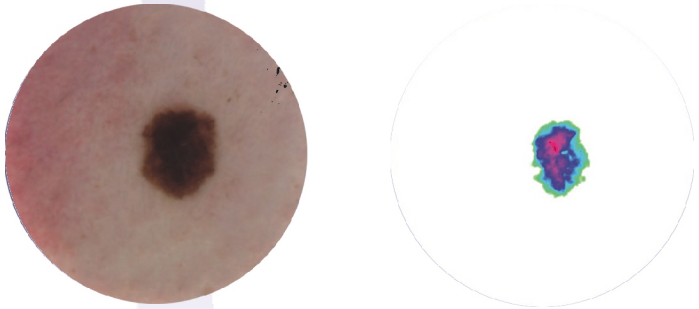

Fig 3. Dermal melanin SIAgraph of the same lesion showing dermal melanin of varying concentration throughout the lesion.

by the fact that each criteria within the checklist may require the identification of more than one feature and may have one or more conditions applied to it. For example the assessment of blue-whitish veil requires 6 decisions - is there a structureless area, is this area blue, is the blue confluent, is there an overlying 'ground-glass' film and are these features irregular and do they not occupy the entire lesion. Future work will assess the ability of clinicians, nurses and students inexperienced in the use of the SIAscope to apply this scoring system after a short (30 minute) training session.

A crucial difference between the two scoring systems is that the dermatoscopic method requires the clinician to determine whether the lesion is melanocytic in origin or not before it can be applied. This adds another layer of complexity to the diagnostic process and, necessarily, a greater source of diagnostic error. Most clinicians regularly diagnosing pigmented skin lesions will have sympathy with the colleague who is surprised on receiving the histopathological diagnosis of melanoma on a lesion that was clinically thought to be a seborrheic keratosis or similar. Diagnostic error at this key step may occur as this requires the assessment of the presence or absence of a further 14 features (Pehamberger et al 1987) and almost all dermatoscopy techniques require this. In contrast the SIAscopic scoring system was developed on a dataset comprising all pigmented skin lesions not just those that are melanocytic. Therefore the user is not required to perform this step, avoiding subjective and clinical error that may occur as a result.

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