Dermoscopy and the diagnosis of melanoma

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Abstract

Melanoma rates in New Zealand are among the highest in the world. Early diagnosis and excision of primary melanoma improves the prognosis. General practitioners should be familiar with the risk factors for melanoma and the clinical appearance of superficial spreading melanoma, lentigo maligna melanoma, nodular melanoma and acrolentiginous melanoma. Suspicious lesions should be referred to an expert for clinical diagnosis including dermoscopy, or where this is impractical, excised. Digital teledermoscopy (mole mapping) is a screening alternative for patients at increased risk of melanoma, especially those who have numerous or clinically atypical melanocytic naevi.

Keywords

Melanoma, dermoscopy, mole mapping

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Introduction

Melanoma[1,2] and melanoma mortality rates in New Zealand are among the world's highest and account for about 200 deaths each year. Melanoma is the most common registered cancer and the fourth most common cause of cancer death among the 15–44 year age group. The pattern of incidence is 10–30% in young adults, 30–40% in middle age and 40–55% in old age. The majority (perhaps 90%) can be attributed to sun exposure.[3]

Melanoma and melanoma mortality rates in New Zealand are among the world's highest and account for about 200 deaths each year

Risk factors for melanoma include:

- White skin that burns easily and tans poorly (skin phototypes 1 and 2)
- Red hair and freckles
- Past sunburn, particularly blistering sunburn
- Numerous melanocytic naevi
- Atypical melanocytic naevi
- Giant congenital melanocytic naevus (diameter >20cm)
- Past history of melanoma (at least 10% risk of a second one)
- Family history of melanoma especially in two or more first degree relatives
- Past history of non-melanoma skin cancer.

Early identification of melanoma is potentially life saving. Early lesions are thinner. Scottish data showed that five-year survival for patients with melanoma thinner than 1.5 mm was 93% among males and 97% among females. In those with melanoma thicker than 3.5 mm it was 47% in men and 55% in women.[4]

The patient may present with a changing naevus, a new lesion or for an unrelated reason. Melanoma can arise within a melanocytic naevus (30–50%) or in previously clinically normal skin. The entire skin surface should be examined closely under a good light including scalp, soles, nails, oral mucosa and eyes.

Lesions clinically suspicious of melanoma should be excised with a 2–5mm margin by the general practitioner if he/she feels they are technically competent to do so, or the patient should be referred to an appropriate specialist (e.g. dermatologist, plastic surgeon, general surgeon, etc).

All lesions removed from the skin must be examined by a histopathologist. The pathologist's report will include the macroscopic description of lesion and diagnosis. If it is a melanoma, the report will include the depth of invasion in millimeters

(Breslow thickness) and the width of margins (lateral and deep). Radial versus vertical growth phase and the presence of ulceration, regression, satellitosis, lymphatic invasion may also be included.

It is a legal requirement to report cases to the New Zealand National Cancer Registry. Refer to the New Zealand Guidelines on the general management of malignant melanoma (2004) [http://dermnetnz.org/dn.paper1/dn.paper1.html, last accessed 12 April 2004].

Melanoma is frequently clinically misdiagnosed. Dermatologists are reported in several reviews to be more reliable than other medical practitioners at diagnosing melanoma accurately[5] but even dermatologists remove many benign lesions unnecessarily (false positive diagnosis) and occasionally fail to remove what later turns out to be melanoma (false negative diagnosis). The main differential diagnoses are benign melanocytic naevi and atypical naevi in young adults, and seborrhoeic keratoses and pigmented basal cell carcinoma in older patients.

Superficial spreading melanoma

- Superficial spreading melanoma is most common on the trunk in men and women and on the legs in women.
- It is clinically characterised by ABCD criteria, i.e. Asymmetry, Border irregularity, Colour variation and Diameter greater than 6mm. Colour may include shades of red, brown, blue, white, and black (Figures 1, 2, 3, 4). Smaller lesions are often identified and removed.
- In-situ superficial spreading melanoma (Clark's level 1) is the radial growth phase, i.e. neoplastic cells are confined to the epithelium. It is non-invasive and lacks the biologic potential to metastasise.
- Invasive superficial spreading melanoma has radial growth and vertical growth components. Clark's Level 2 invades superficial papillary dermis, Level 3 invades reticular dermis, Level 4 fills the reticular dermis and Level 5 invades subcutaneous tissue.
- Prognosis mainly depends on histological tumour thickness (Breslow depth) and is worse if the lesion is ulcerated or shows regression.

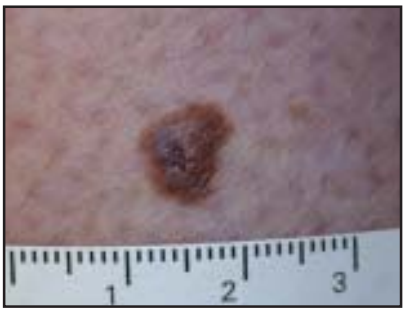

Figure 1

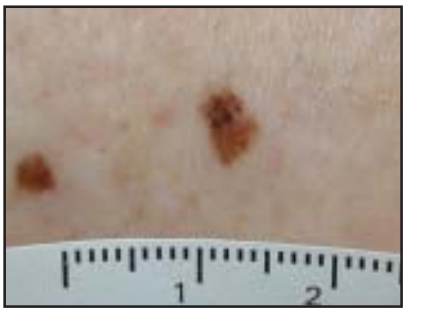

Figure 2

In-situ superficial spreading melanoma found in 2002 on the lower leg (Figure 1) and in 2003 on the thigh (Figure 2) of a patient who had had an invasive melanoma excised several years ago.

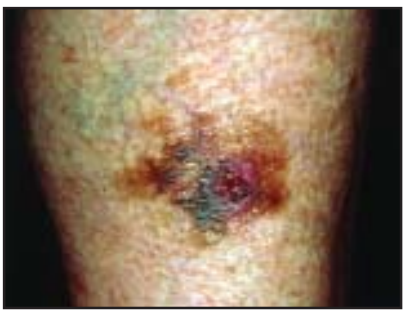

Figure 3. Large superficial spreading melanomaon the lower leg

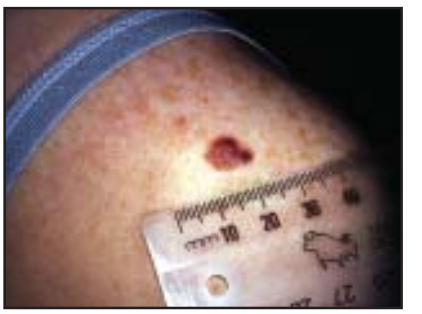

Figure 4. Early invasive superficial spreading melanoma

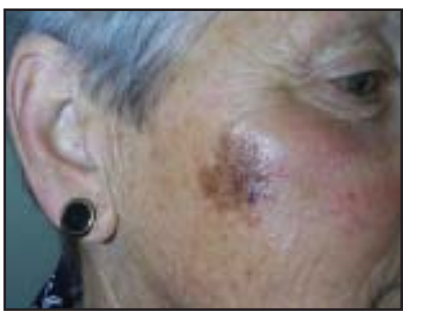

Figure 5. Typical lentigo maligna

Lentigo maligna melanoma

- Lentigo maligna is also known as Hutchinson's melanotic freckle. It is a subtype of in situ superficial spreading melanoma typically located on sun-damaged head, neck, and arms (Figures 5, 6).
- Lentigo maligna may slowly enlarge for many years prior to developing invasive melanoma (lentigo maligna melanoma).

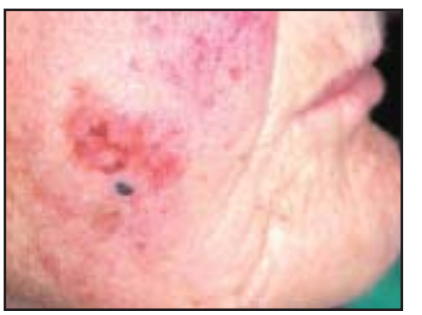

Figure 6. The blue papule indicates lentigo maligna melanoma

Nodular melanoma

- Nodular melanoma is most commonly seen on the legs and trunk.
- There may be a history of rapid growth over weeks to months.
- It presents as a dark brown-to-black papule or dome-shaped nodule, which may ulcerate and bleed with minor trauma (Figures 7–9).
- Nodular melanoma frequently do not present with ABCD criteria.
- Non-pigmented amelanotic melanoma appears clinically as pink or flesh coloured and often mimics basal cell or squamous cell carcinoma.

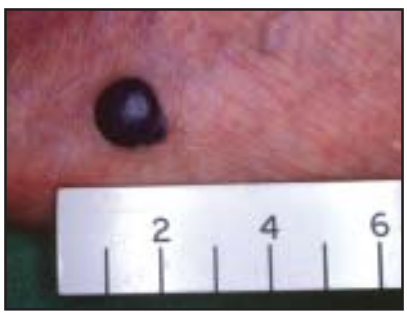

Figure 7. Nodular melanoma on the foot

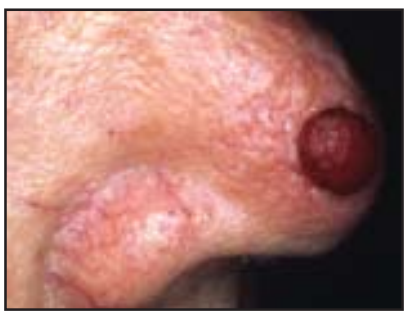

Figure 8. Amelanotic nodular melanoma

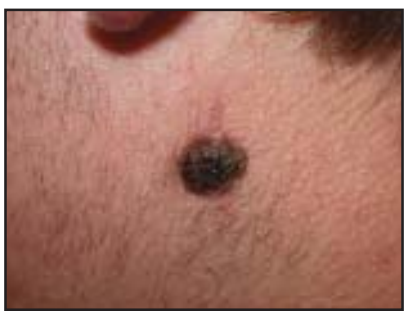

Figure 9. Bleeding crusted nodule

Acrolentiginous melanoma

- Acrolentiginous melanoma is the least common subtype of melanoma in skin types 1, 2 and 3 but is the most common type in dark-skinned individuals with skin type 4, 5 and 6 (Figure 10).
- It occurs on the palms, soles, or beneath the nail plate (subungual variant).
- Subungual melanoma presents as diffuse nail discoloration or a longitudinal pigmented band within the nail plate (Figure 11).

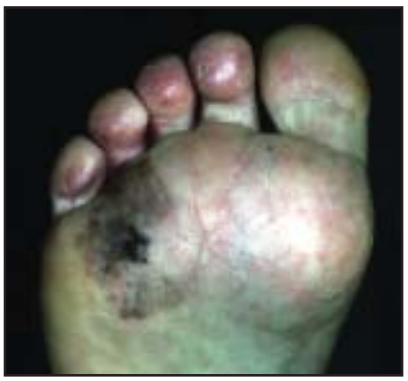

Figure 10. Acrolentiginous melanoma

Figure 11. Subungual melanoma

Rare types of primary melanoma

- Mucosal melanoma has lentiginous or freckle-like histology (Figure 12).
- Malignant blue naevus is a primary melanoma arising within a dermal blue naevus. It is blue because of the depth of the pigmentation (Figure 13).

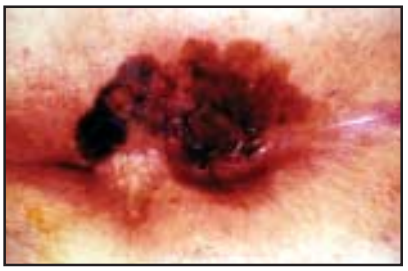

Figure 12. Perianal mucosal melanoma

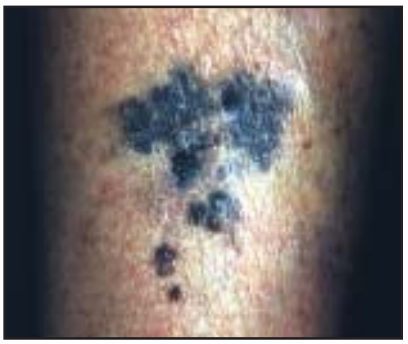

Figure 13. Malignant blue naevus

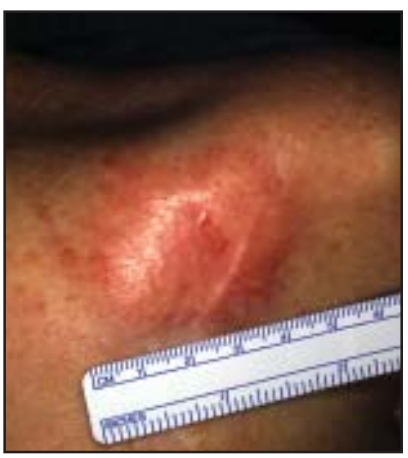

Figure 14. Desmoplastic melanoma

- Desmoplastic melanoma is a fibrous neurotropic tumour that tends to be diagnosed late and has a poor prognosis (Figure 14).

Metastatic melanoma

- Cutaneous metastatic melanoma may be in transit to local lymph nodes or disseminated (Figures 15, 16).

- It occasionally presents without a known primary, presumably because of involution or central nervous system origin.
- It is frequently amelanotic because the cells have become poorly differentiated.
- Metastatic melanoma has a very poor prognosis.

Dermoscopy in the diagnosis of primary melanoma

Dermoscopy (also known as dermatoscopy, epiluminoscopy, epiluminescence microscopy and skin surface microscopy) refers to the use of a hand-held magnifying instrument to examine the skin, particularly pigmented lesions. Dermoscopy increases accuracy of diagnosis of melanoma in trained and experienced practitioners.[6] It may conversely decrease diagnostic performance in untrained users.[7] Unfortunately, skin surface microscopic changes can be subtle and difficult to distinguish and even well-trained and experienced dermoscopists do not claim greater than 90% accuracy.

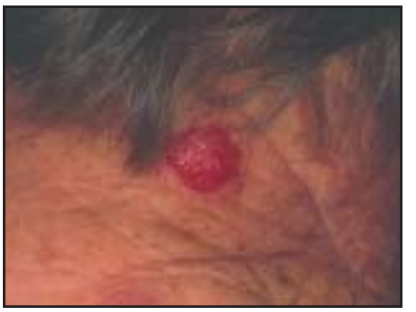

Figure 15. Solitary amelanotic metastasis

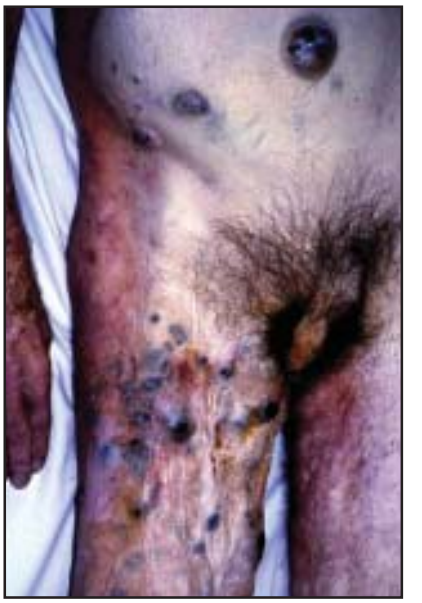

Figure 16. Multiple metastases

Melanocytic lesions

Melanocytic lesions are recognised dermoscopically by the following features:

- Pigment network (Figures 17, 18)
- Aggregated globules (Figure 19)
- Amorphous areas (Figures 20–22).

Benign melanocytic naevi can be confidently diagnosed if the pigmentation pattern is symmetrical and homogeneous, particularly if it is a single colour.

Benign melanocytic lesions (Figures 17–22)

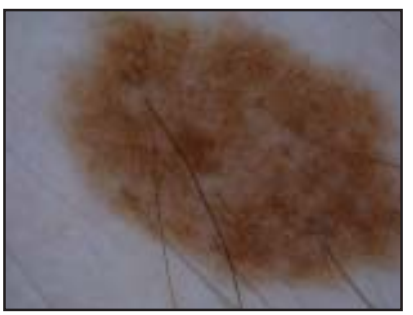

Figure 17. Network pattern

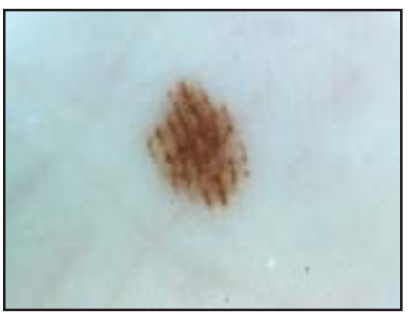

Figure 18. Parallel network on sole

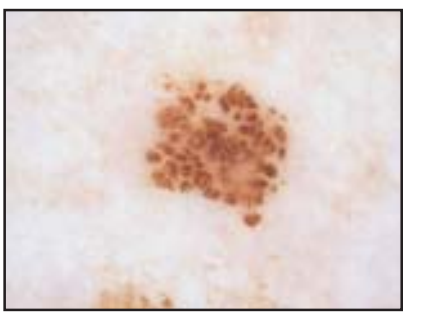

Figure 19. Aggregated globules

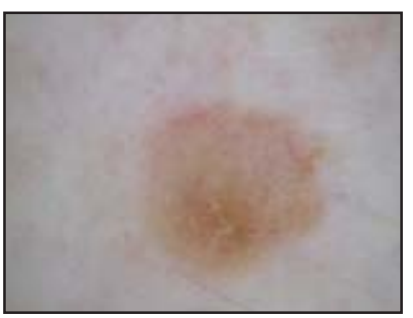

Figure 20. Homogeneous pigmentation (melanocytic naevus)

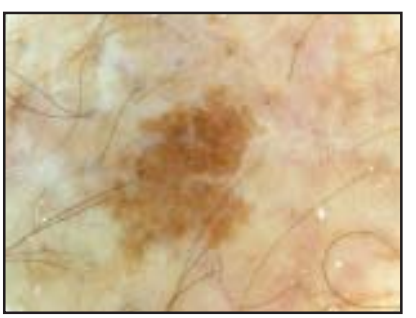

Figure 21. Homogeneous pigmentation (facial solar lentigo)

Figure 22. Homogeneous pigmentation (blue naevus)

Seborrhoeic keratoses

The dermoscopic characteristics of seborrhoeic keratoses are:

- Multiple milia-like cysts (Figure 23)
- Irregular crypts (Figure 24)
- Fissures (Figure 25)
- Fingerprint-like structures (Figure 26)
- Multiple blue-grey globules (Figure 27).

However, sometimes these features appear in dermal naevi and melanoma.

Pigmented basal cell carcinoma

Pigmented basal cell carcinomas are distinguished dermoscopically by the presence of:

- Arborizing blood vessels (Figure 28)
- Maple leaf-like or spoke-wheel areas
- Blue ovoid nests or globules (Figure 29)
- Ulceration (Figure 30).

Haemangioma

Vascular lesions can be confidently diagnosed when there are widespread red-blue lacunes or red-bluish-black homogeneous areas (Figures 31–33).

Melanoma

The diagnosis of melanoma can be very difficult. Helpful features include:

- Asymmetrical pigment pattern (Figures 34, 35)
- Multiple brown, black or grey dots (Figure 36)
- Broadened network, pseudopods and radial streaming (Figure 37)
- Multiple (3–6) colours especially scar-like depigmentation and blue-white veil (Figures 35–42)
- Rhomboidal structures (lentigo maligna; Figure 41)
- Parallel ridge pattern (acro-lentiginous melanoma; Figure 42).

Just as it may be difficult to diagnose clinically, nodular melanoma may have non-specific dermoscopic features (Figure 43).

Seborrhoeic keratoses (Figures 23–27)

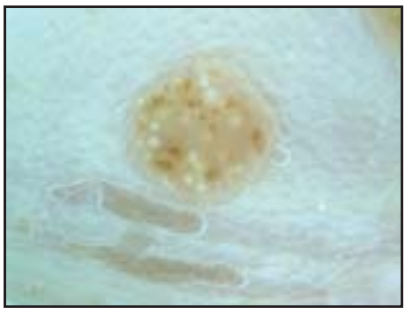

Figure 23. Milia-like cysts

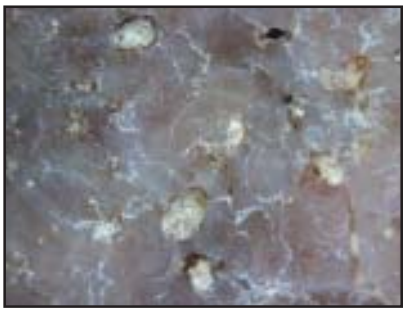

Figure 24. Irregular crypts

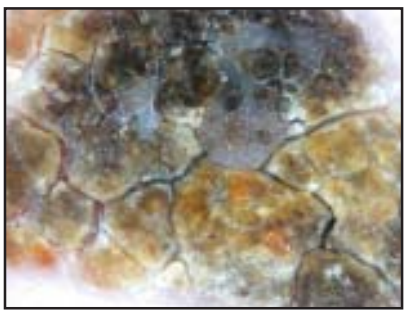

Figure 25. Fissures

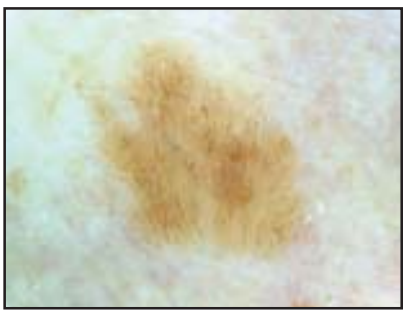

Figure 26. Fingerprint-like structures

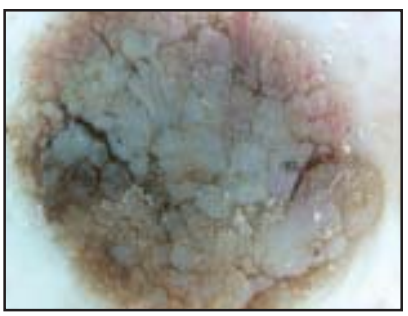

Figure 27. Blue-grey globules

Pigmented basal cell carcinomas (Figures 28–30)

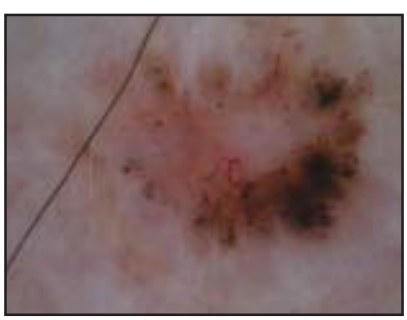

Figure 28. Arborizing blood vessels

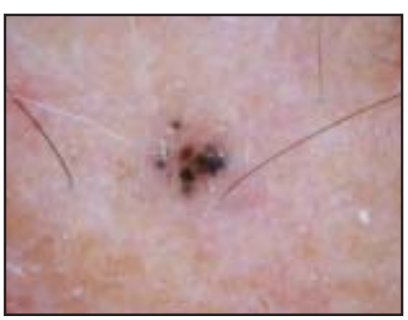

Figure 29. Blue ovoid nests

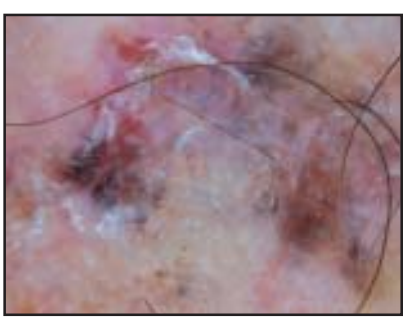

Figure 30. Ulceration

Haemangiomas (Figures 31–33)

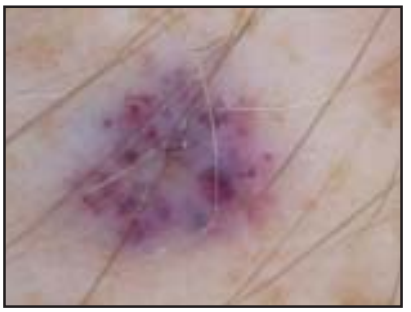

Figure 31

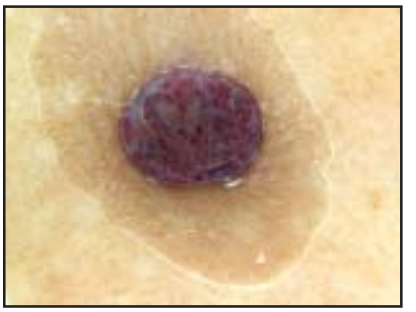

Figure 32

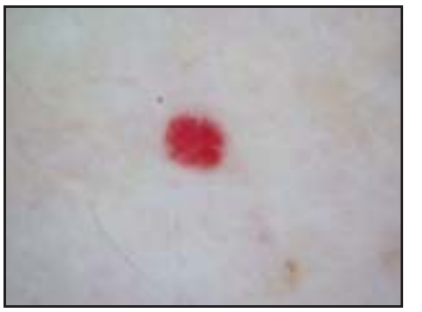

Figure 33

Atypical naevi

Atypical naevi, or 'funny-looking' moles, are common and frequently confused with melanoma. Multiple atypical naevi may indicate a patient's predisposition to melanoma, particularly if there is a family history of melanoma (atypical mole or dysplastic naevus syndrome). Several authors have described dermoscopic features discriminating between atypical naevi and melanoma. These require expert interpretation and may be misleading (Figures 44–49).

Screening for melanoma

There are no good published studies of the effectiveness of screening clinical examination by a primary care provider in reducing the mortality of melanoma.[8] However, it seems reasonable to suggest that all medical practitioners should perform opportunistic skin checks in patients at risk of melanoma (everyone!). Those with fair skin, sun damage, a history of skin cancer, multiple melanocytic naevi, one or more atypical naevi and/or outdoor occupation should be encouraged to have regular skin checks at three to 12-month intervals depending on risk factors.

However, visual examination of the skin in asymptomatic individuals leads to unavoidable increases in harmful consequences.[9] Excising benign lesions is unnecessarily invasive, very expensive, and leaves scars. Excising too few lesions may

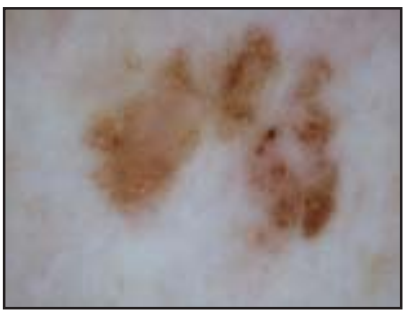

Figure 34. Asymmetrical pigment pattern in melanoma in situ (network, homogeneous and globules)

Figure 35. Non-specific structures; 0.75 mm superficial spreading melanoma

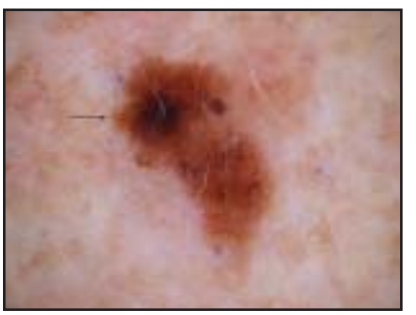

Figure 36. Multiple brown dots (see arrow); 0.6 mm superficial spreading melanoma

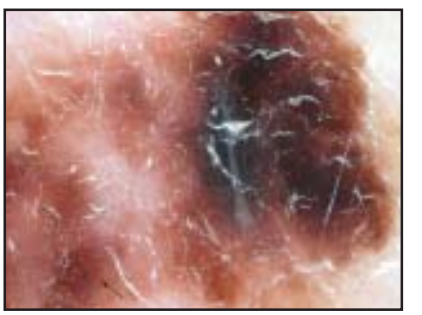

Figure 37. Broadened network (see arrow); 0.6 mm vertical growth phase melanoma

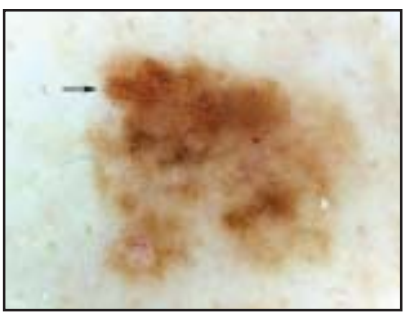

Figure 38. Radial streaming (see arrow); Melanoma in situ

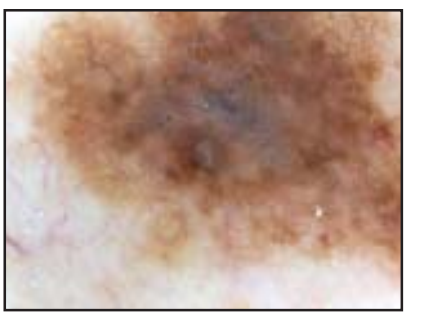

Figure 39. Multiple colours (light brown, dark brown, black, grey, red, blue); Melanoma in situ

result in missed melanomas. Selected patients should instead be referred to a specialist dermatologist for clinical and dermoscopic examination, particularly those with multiple atypical naevi, melanoma and/or other forms of skin cancer. However, it is not practical for every 'moley' patient to see a dermatologist face-to-face, as specialist appointments are in short supply.

Digital photographic screening or 'mole mapping' systems offer a realistic alternative. To date there is no published evidence to support nationwide melanoma screening programmes like that offered for cervical and breast cancers. However, research is ongoing to determine the value of privately funded dermatologist-led digital imaging programmes.

In March 2004, approximately one thousand appointments were made at MoleMap screening centres

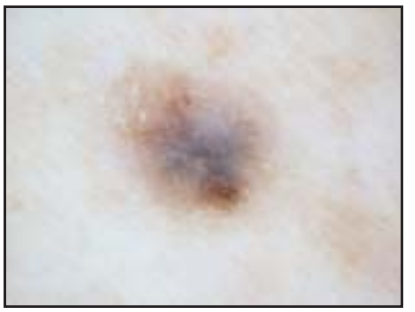

Figure 40. Blue white veil; 0.35 mm superficial spreading melanoma

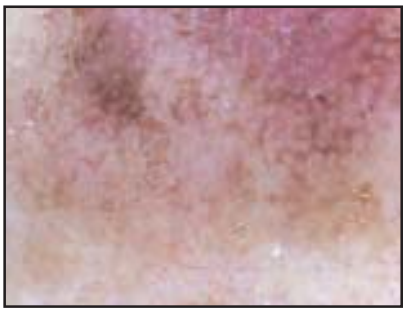

Figure 41. Rhomboidal structures (lentigo maligna)

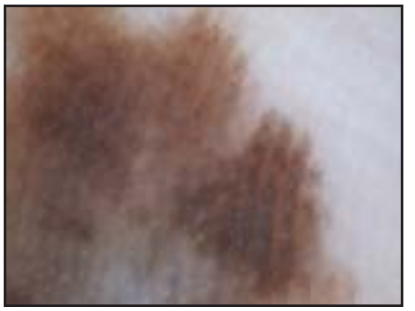

Figure 42. Parallel ridge pattern (acrolentiginous melanoma in situ)

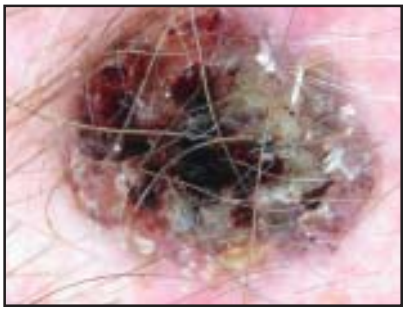

Figure 43. Non-specific features of bleeding 3.7mm nodular melanoma (see Figure 9)

Atypical naevi (Figures 44–49)

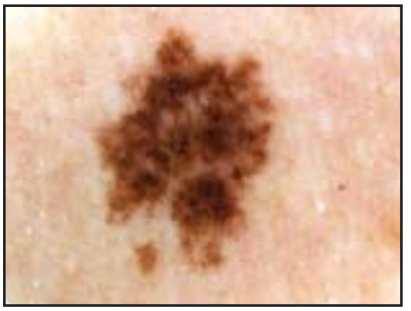

Figure 44

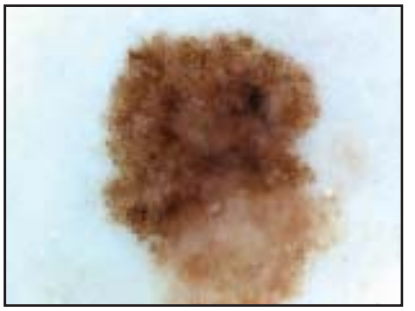

Figure 45

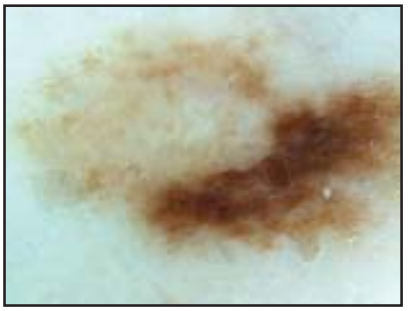

Figure 46

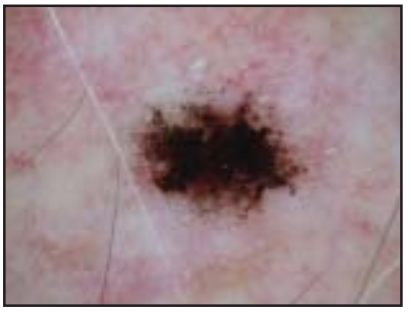

Figure 47

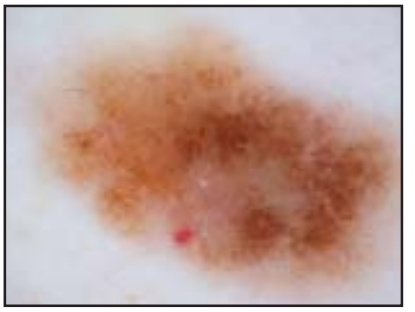

Figure 48

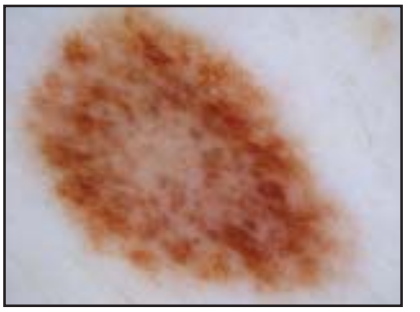

Figure 49

Figure 50. Mole mapping (image supplied by MoleMap)

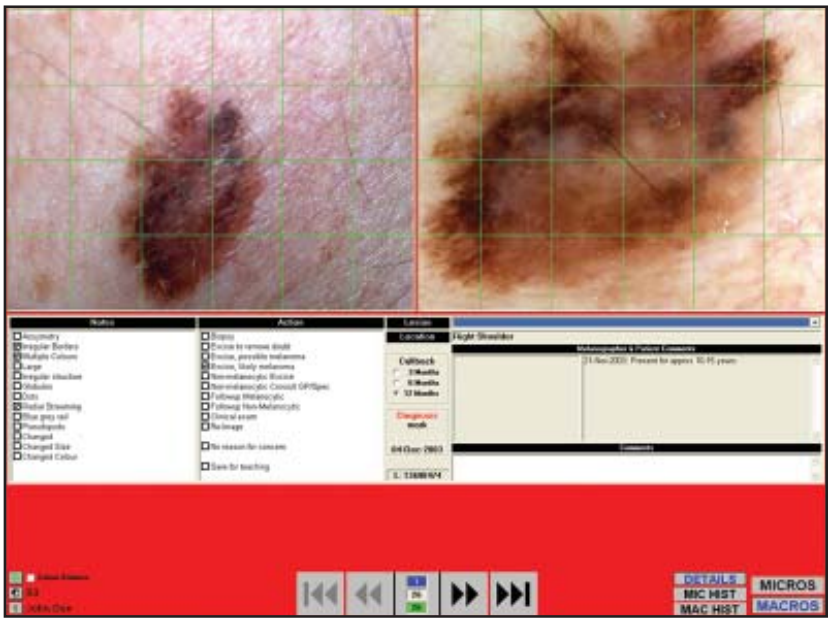

Figure 51. Mole mapping Reporting window (image supplied by MoleMap)

following referral by general practitioners and in response to advertisements [personal communication, see http://www.molemap.co.nz/, last accessed 24 April 2004.]. MoleMaps start with an interview by the 'melanographer' (who is a registered nurse, medical photographer or other allied health professional) to determine past history of skin cancer and risk factors for melanoma (skin phototype, occupation, leisure activities, family history etc.). A series of 28 images of the body surface are recorded using a specially adapted digital camera (Figure 50). They do not normally include views of the scalp or genitals. Standardised close-up images are then taken of pigmented lesions of concern. These may worry the patient or referring doctor, or have pre-determined characteristics such as large size, irregular shape, multiple colours or other atypical features. Dermoscopic images are also taken of these lesions, which may number 100 or more. An appointment for full screening of a new patient takes about an hour on average and costs $195 (September 2004). GPs may also refer patients for imaging of specified lesions.

Within a few days, a diagnosing dermatologist views the historical data and digital images, often at a remote location (teledermatology, teledermoscopy). Proprietary software displays images of each lesion and reporting options (Figure 51). The dermatologist can report on the features of concern, make a provisional diagnosis and recommend specific management of suspicious lesions. Options include referring the patient to their doctor for clinical evaluation, biopsy or excision of the lesion, and re-imaging the lesion after a specified length of time.

A standardised report is sent to the patient and their general practitioner, and may include printed clinical images of specific lesions.

The patient is generally advised to re-attend in 12 months for follow-up screening. Re-imaging of worrying lesions is particularly valuable as recognition of subtle dermoscopic changes can allow early excision of suspicious lesions (Figures 52–54).

Melanomas diagnosed by mole mapping

Over the last six years, more than 20 000 individuals have had over 500 000 lesions imaged by MoleMap NZ. The diagnosing dermatologists recommended excision of 0.5% or 2500 melanocytic lesions. It is not known how many of these have actually been removed, as MoleMap is not always provided with the histological report.

In 2003, an internal evaluation of pathology reports of 119 melanocytic lesions indicated that 19 were melanomas (nine in situ), giving a positive predictive rate of 1:6.3 (16%) and false positive rate of 84%. Twenty-one of the remaining lesions were atypical or dysplastic naevi (data on file). There is no published standard for desirable excision rates and the rate of false positive excisions in New Zealand in other settings is unknown.

However, these rates are comparable to those made in 133 individuals with 2542 pigmented lesions, which were examined by an Italian group of dermatologists. They found 43 clinically suspicious lesions. Thirteen also had suspicious dermoscopy and were excised. Three were melanomas, with an increase in specificity from 98.4% by clinical examination to 99.6% with dermoscopy, and an increase in positive predictive value from 6.9% to 23%.[10] The same group performed a retrospective audit of 3053 excised melanocytic lesions (319 melano-

Changing melanocytic lesion, histologically an inflamed dysplastic naevus

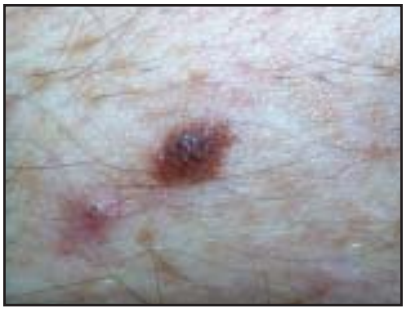

Figure 52. Macro image of skin lesion in March 04

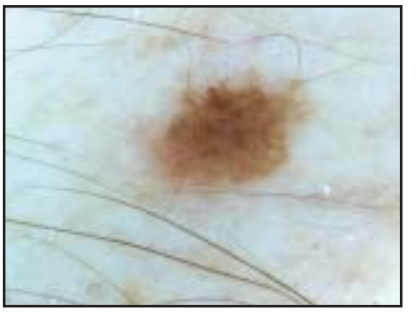

Figure 53. October 03: mildly abnormal pigmentation and structure.

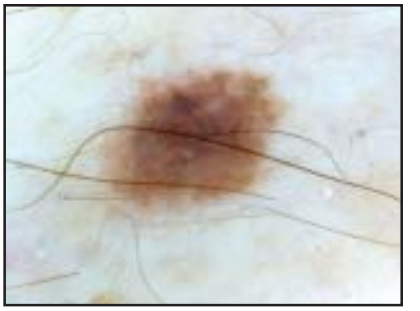

Figure 54. March 04: the lesion has enlarged and has subtle structural changes (images have identical magnification).

mas) and found the malignant/benign ratio improved in dermoscopy users from pre-dermoscopy rates of 1:18 (5.6%) in 1997 to 1:4.3 (23.3%) in 1999–2001. No significant difference was found for nonusers (from 1:11.8 to 1:14.4).[6]

An audit of data on 4741 pigmented skin lesions excised by 468 general practitioners in Western Australia found 62 in situ and 98 invasive melanomas (positive predictive rate 3.4%).[11] Assuming that New Zealand general practitioners excise a similar excess of benign lesions, we can predict that diagnosis by digital teledermoscopy (MoleMap) is significantly more accurate than that made in vivo by a general practitioner. We suspect it is slightly less accurate than that made in vivo by a dermatologist well trained in dermoscopy. However, face-to-face consultations include other decision-making factors such as patient pressure to excise and economic factors.

Because patients are encouraged to re-attend for re-screening, it is hoped to minimise the danger that potential false negative diagnoses have been made by mole mapping (i.e. an assumption that an examined lesion is benign and does not require excision) or that malignant lesions were missed because they were not imaged.

Many patients that attend MoleMap clinics have concerns about new non-pigmented lesions, most often basal cell carcinomas. These patients are directed to see their general practitioners to confirm clinical diagnosis and arrange further management. Of a further 46 histology reports received by MoleMap, 31 were basal cell carcinomas and four were squamous cell carcinomas (two in situ). Seven were seborrhoeic keratoses.

It has proved extremely difficult to programme automated diagnosis systems to distinguish malignant from benign melanocytic lesions as accurately as an experienced clinician

Planned research will audit concordance between dermatologists and will include duplicate reporting of samples of images in which the histology is known, and face-to-face examination of a selection of mapped patients.

Automated systems

It has proved extremely difficult to programme automated diagnosis systems to distinguish malignant from benign melanocytic lesions as accurately as an experienced clinician. The process requires capture of the image, segmentation (identifying the lesion within the image), analysis (measuring certain features) and classification (an attempt at diagnosis).

Segmentation requires the perfect picture; in focus, correctly exposed, no hair, no air bubbles or flash artefact, a flat skin surface and clear lesion borders. Analysis may measure lesion symmetry, border irregularity, colour variegation or some form of automated computer analysis of characteristics that have little meaning to humans. Classification depends on comparing characteristics with a training set of images with known diagnoses but may not be accurate for all possible skin lesions.

Although some research studies have published promising results under experimental conditions, the practical value of automated diagnostic instruments under real-world conditions is currently unknown.[12] However, there are several companies marketing monitoring systems with some diagnosing capacity. There are no comparative studies and they use different data sets.

Polartechnics Ltd SolarScan® (Sydney Melanoma Unit and Commonwealth Scientific and Industrial Research Organisation's system) captures a video image, segments it then analyses over 100 variables and compares these to an integral clinical database. [http://www.polartechnics.com.au/, last checked 12 April 2004]

Melafind™ (Electro Optical Sciences) claims to 'outperform the top skin cancer specialists' (with 100% accuracy using a training set of images) and has the 'goal of securing FDA clearance'. [http://www.melafind.com/, last checked 12 April 2004]

MoleMaxII™ (Derma Instruments and University of Vienna Medical School Department of Dermatology) is a video imaging system with computer aided diagnostic tools (Expertizer™) that analyses and compares a new lesion with clinical reference pictures. [http://www.molemaxii.com/, last checked 12 April 2004].

Conclusion

Early diagnosis of melanoma potentially saves lives. Clinical examination including dermoscopy improves the accuracy of diagnosis but is not entirely reliable. Suspicious pigmented lesions should be observed carefully for change or removed for histological diagnosis. Imaging systems such as MoleMap offer expert Telemedical diagnosis and ongoing monitoring. Automated diagnosis systems are currently experimental but may prove valuable in the future.

Conflict of interest

Dr Oakley is a diagnosing dermatologist for MoleMap.

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Culture and the New Zealand Health Reforms 1993

'Cultural factors proved at least as important as economic ones as the story of the health reforms unfolded. Culture may be regarded as an acquired system of values, beliefs, knowledge, and behaviour shared within a group, or more simply, "the way we do things around here." Colonisation of one culture by another results in major changes in power structures, decision making, resource allocation, social structures and networks, concepts and language, and dominant values and beliefs – all of which were apparent in the health reforms. Whatever the rhetoric of the reforms, the imposition of a market driven health system challenged widely held and cherished assumptions and existing values and practices. Major differences between clinical and commercial cultures became apparent. A high level of tension is inevitable in organisations where there are strong and competing pressures to maintain the separate identity of different subcultures and at the same time achieve organisational integration. Clinical and commercial cultures need not be polarised but became so in New Zealand's reforms.'

Hornblow A. New Zealand's health reforms: a clash of cultures. BMJ 1997; 314:1892.