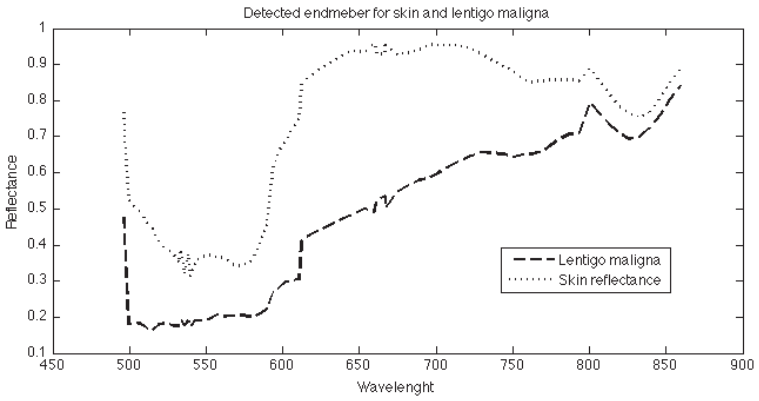

Fig. S1. The spectral endmembers (pure spectra) representing healthy skin and lentigo maligna.

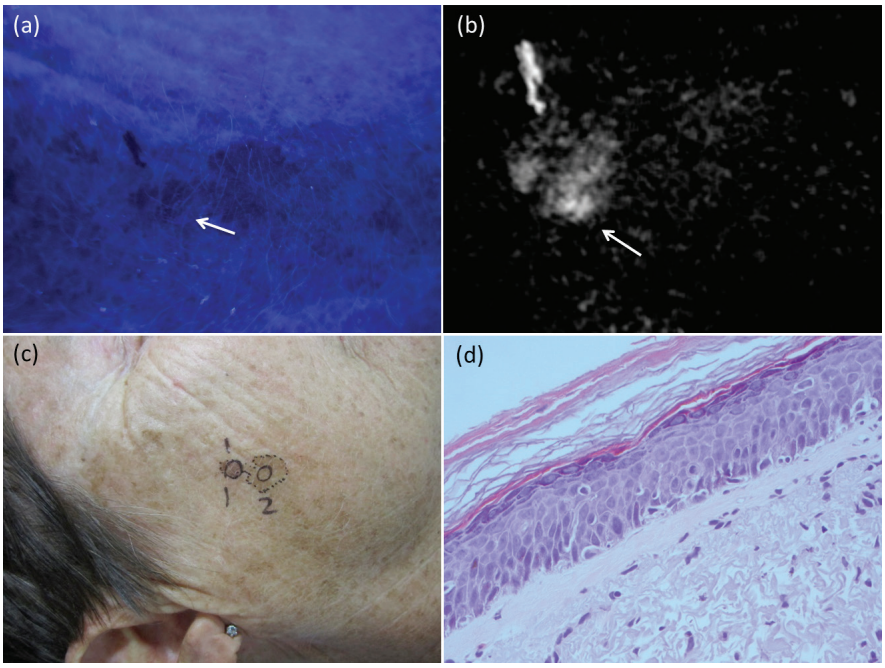

Fig. S2. Lentigo maligna (LM) in the cheek area surrounded by benign lentigines (patient 8). (a) Lesion in Wood's light showing inaccurate lesion margins (arrow), (b) HIS abundance map detecting only the cranial part of the lesion as LM (arrow), (c) Sites of the punch biopsies, (d) Histological image (HE staining, magnification ×2 0) of biopsy No. 1 showing histological findings of LM: atypical melanocytes at the dermal-epidermal junction and intraepidermally. Solar elastosis is present. Histologically only the cranial part of the lesion (biopsy No. 1) was verified as LM and the caudal part (biopsy No. 2) was a benign lentigo. The wide excision of the lesion verified these results.

Appendix S1

Detailed description of the hypespectral imager and data analysis

The principle of the hyperspectral imager (500–850 nm) is based on multiple orders of the Fabry-Perot Interferometer (FPI) that are used to match the different sensitivities of the image sensor channels (10). When the FPI's air gap range is selected correctly, there will be one to 3 spectral transmission peaks, which are recorded with a normal RGB colour image sensor. The detector utilised in this study is a CMOS RGB image sensor MT009V022. After capturing the image, the spectral information can be retrieved from the Bayer colour filter pattern of RGB sensors. Hyperspectral imager is calibrated using an integrating sphere (11).

The holder had a tube to remove the diffuse background illumination of surrounding light and to standardise the distance between the skin and lens and thus the spatial resolution. The light source used (Dolan-Jenner DC950H without infrared filter) consisted of visible and infrared light. To achieve homogeneous illumination for the whole imaging area a diffusing film was placed in front of the ring light. The imaging system was optimised for flat surfaces. The imaging system's holder had changeable tubes with variable diameters for round surfaces like the nose and ears in order to keep the imaged skin surface flat.

The miniaturised hyperspectral imager was based on a piezo-actualised Fabry-Perot interferometer (FPI), which enabled the capture of an entire spectral frame quickly by changing wavebands. Each spectral layer was captured within 100 ms resulting in a few seconds imaging time for the whole spectral cube. Spatially 1 mm represented 8 pixels in the image. The captured spatial area (field of view) was approximately 12 cm^2. The diffused ring light produced homogenous spatial illumination of the target.

To reduce noise the sensor level dark current response was subtracted from the image. The data was converted to reflectance values using white reference X-Rite M50103 ColorChecker. Basically, this means that if X_i is recorded spectra then reflectance is $R_i=(X_i-B_i)/(W_i-B_i)$, where W_i and B_i are spatially corresponding spectra from black current and white reference. This was done for all the spectra in hyperspectral images.

The reflectance data was processed with vertex component analysis (VCA) to detect end-members (i.e. pure pixels) from the spectral data (12). VCA is based on a linear mixture model, which assumes that spectra are linearly mixed. We used VCA iteratively, so that the algorithm was run a couple of times to determine an accurate number of endmembers in the data. We used the filter vector algorithm (FVA) (13), because of its low computational cost and because the results did not significantly diverge from the non-negative least square inversion (14). As a result we obtained abundance images representing determined end-members (5–8 per patient). These abundance maps representing the diffuse reflectance of the lentigo maligna (LM) and surrounding skin were used to delineate the lesions borders. Fig. S1[1] represents the typical endmembers determined for healthy skin and LM. Fig. S2[1] represents the comparison between the clinical situation, hyperspectral abundance map and histology.

Table SI. *Technical details of the hyperspectral imager*

Parameter	Specified value	Remarks
Minimum object distance	> 30 mm	The focal length is 9.3 ± 0.3 mm
Horizontal field of view	> 36º	
Vertical field of view	> 26º	
System focal length	9.3 ± 0.3 mm	Full custom lenses
Spectral resolution	9…40 nm @ FWHM	Pending on the used FPI air gap
Spectral step	< 1 nm	By controlling the air gap of the FPI
F-number	< 6.7	The f-number depends on FPI diameter.
Default spectral image dimensions	640 × 480 pixels	One physical pixel is 4 × 4 binned pixel of 2.2 × 2.2 µm pixels = 8.8 × 8.8 µm.
Maximum spectral image size	2,592 × 1,944 pixels	2.2 µ × 2.2 µm pixels, no binning
Dimensions	62 × 56 mm/66 × 140 mm/219 mm	Without/with the Macro 1&2 Optics
Weight	~ 450 g (camera only), 1.2 kg (handheld device)	

FWHM = full width half maximum
FPI = Fapry-Perot interferometer