A new mole mapping system for the use of modern high resolution digital cameras

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Objective

Change of a pigmented mole is an important factor in early melanoma detection in high risk patients. It is often difficult to identify changed or new moles in patients follow-up[1,2].
Patients have difficulty detecting mole changes on their back[3].
Our objective was the development of a computer analysis system, which can be used as a screening tool for mole changes.
New developments in the field of digital imaging might allow detailed inspection of lesions in high resolution images.

Requirements for a computer aided mole check

- Automatic detection of moles
- Automatic matching of detected moles
- Detection of changed moles
- Detection of new developed moles
- Measurement of mole area
- Measurement of mole color features
- Support of different transformations (zoom, rotation, strain, displacement) to correct slightly changed imaging conditions
- Support of high resolution images

Methods

High resolution digital images are required for the analysis. Two similiar follow-up images of a relevant body site of one patient were compared using a new developed algorithm. The quality of the algorithm was tested on computer generated images.

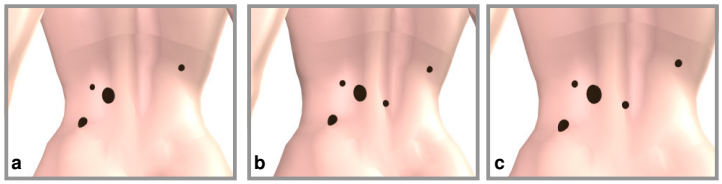

Fig. 1: Computer generated test images for verification of the transformation algorithm (a - standard, b - rotated, c - zoomed).

Description of algorithm

1. Mole detection in each image with scoring
2. Automatic selection of the most relevant mole (highest score)
3. Computation of different possible image transformations (zoom, rotation, strain, displacement) based on selected mole constellation
4. Mole matching based on the transformation
5. Correction of transformation using the matching information according to distances of matched moles
6. Repeat 4+5 until no further improvement is possible
7. Final mole matching
8. Comparision of the mole features

Results

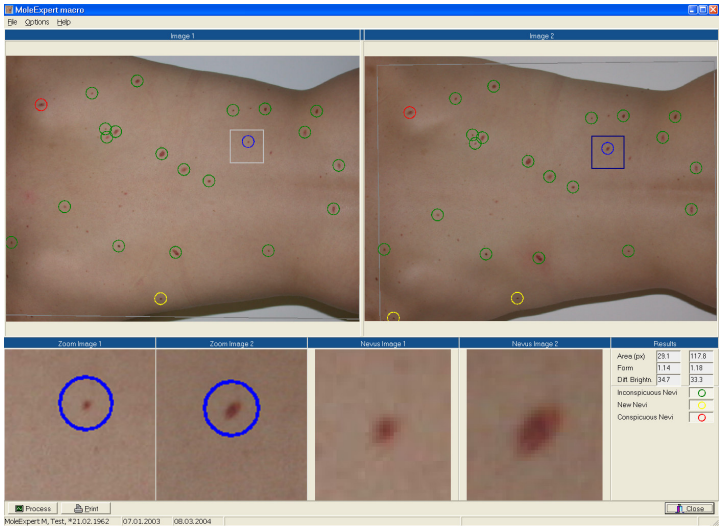

Fig. 2: Screenshot of the software - images were taken in January 2003 and March 2004. Features for each lesion pair can be obtained by clicking on the image. The highlighted pigmented lesion was found to be a melanoma (SSM, tumor thickness 0.4 mm, Clark level III; histology see fig. 3).

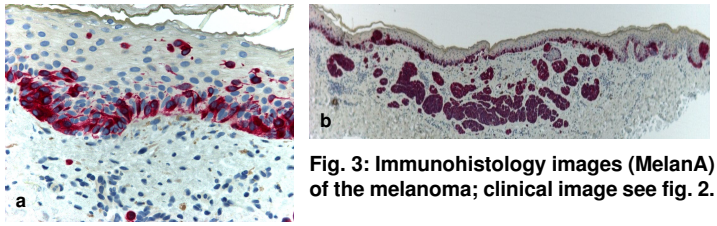

Fig. 3: Immunohistology images (MelanA) of the melanoma; clinical image see fig. 2.

The new analysis system automatically detected moles in the first and in the follow-up image and computed the mapping. Additionally, the software extracted the features size, shape, and color information for each lesion, and these features were compared for all mapped moles.
The analysis results are illustrated and the extracted moles are shown in full resolution giving a detailed image of the lesion.
The example demonstrates the detection of a small melanoma in a patient with multiple atypical melanocytic nevi. Dermatoscopy of the melanoma did not show any suspicious findings compared to other histologically proven benign melanocytic nevi in the same patient. This underlines the importance of the factor "*change* of size, color or shape" in the follow-up of patients with multiple moles.

Immunohistology images were provided by M. Brönnimann, Department of Dermatology, Inselspital, University Hospital Bern, Switzerland

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