Supplementary Online Content

Winkler JK, Fink C, Toberer F, et al. Association between surgical skin markings in dermoscopic images and diagnostic performance of a deep learning convolutional neural network for melanoma recognition. *JAMA Dermatol.* Published online August 14, 2019. doi:10.1001/jamadermatol.2019.1735

This supplementary material has been provided by the authors to give readers additional information about their work.

eMethods. Supplemental Methods

Creating Electronically Superimposed Markings

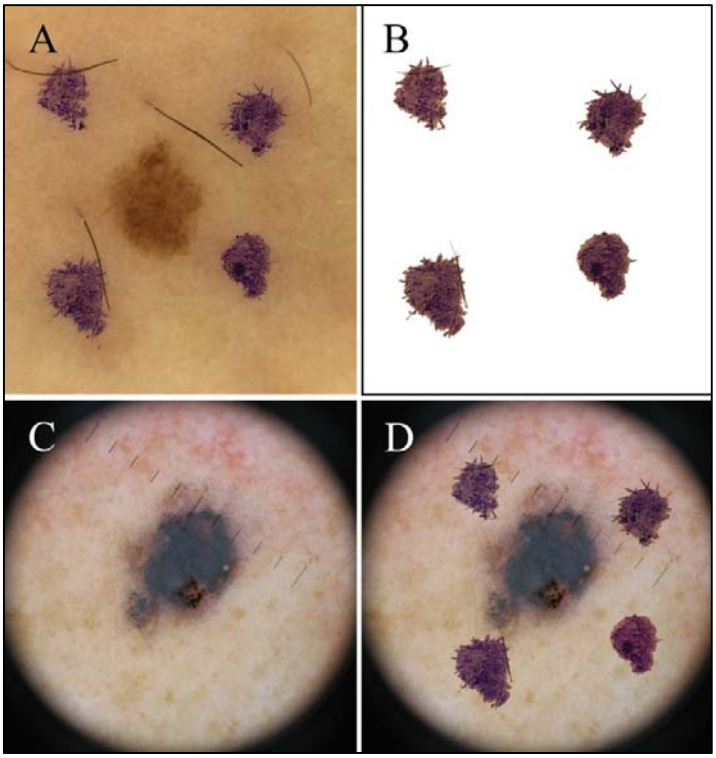
All melanoma images in this study were "electronically" marked by copying markings from images that carried "in vivo" markings. To this end the "magic wand tool" of Adobe® Photoshop® was used (Adobe® Photoshop® CS6, Version 13.0.1 x32, San Jose, CA, USA). This tool selects pixels from an image based on color and tone. Briefly, dermoscopic images (jpg format) showing a selection of markings by a blue surgical skin marker were opened with the Adobe® Photoshop® software. Next, the magic wand tool was used to copy in vivo markings from the image. After opening the dermoscopic images of unmarked melanomas, the copied blue markings were transferred and superimposed to a new Photoshop® layer. Finally, images of marked melanomas were stored in jpg format (eFigure 1).

Validating the Comparability of "In Vivo" Versus "Electronical" Markings

To demonstrate that "electronically superimposed" markings give comparable results to "in vivo" markings, we used 20 nevi from the image set for a statistical comparison of resulting melanoma probability scores. Electronically marked nevi were created by first opening the jpg images of "in vivo" marked nevi with Adobe® Photoshop® software. Then we selected the pixels of the markings with the magic wand tool and copied them to the jpg image of the unmarked image of the same nevus. As a result we attained three images of the same nevus i) original unmarked nevus, ii) "in vivo" marked nevus, and iii) "electronically" marked nevus (eFigure 2). In the representative selection of 20 unmarked nevi the mean melanoma probability score was 0.15 (95% CI [0.01-0.29]). In vivo markings strongly increased the mean score to 0.52 (95% CI [0.31-0.74]), while electronically superimposed markings led to a comparable mean score of 0.59 (95% CI [0.39-0.79]). The Mann-Whitney-U test did not

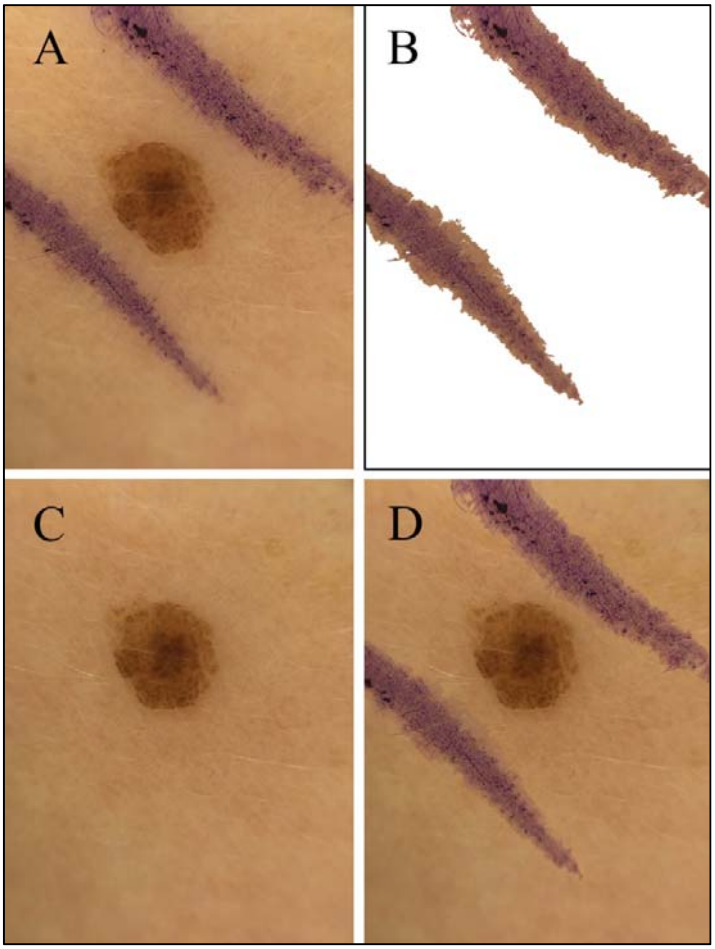
reveal a significant difference between “in vivo” and “electronically” marked nevi (p=0.779). Moreover, in each of the 20 nevi the dichotomous outcome of the CNN classification (benign, malignant) of “in vivo” versus “electronically” marked lesions showed consistent results. Of note, the aforementioned experiment that was used to prove an equal impact of “in vivo” versus “electronical” markings could only be done in nevi and not in melanoma images due to a lack of sufficient numbers of “in vivo” marked melanomas as a comparator to “electronically” marked melanomas.

eFigure 1. Technical Approach of Creating Electronically Superimposed Markings in Melanoma Images



A, a nevus with in vivo markings is shown. B, markings were copied from the image in A by using the magic wand tool of Adobe® Photoshop®. C, an unmarked melanoma (Breslow thickness 0.5mm) is shown. D, copied markings were electronically superimposed on the unmarked image of the melanoma by creating a new image layer.

eFigure 2. Technical Approach for Validating the Comparability of Electronically Superimposed and In Vivo Markings



A, a nevus with in vivo markings is shown. B, markings were copied from the image in A by using the magic wand tool of Adobe® Photoshop®. C, the original image of the same nevus but without markings is shown. D, copied markings were electronically superimposed on the unmarked image of the nevus by creating a new image layer. When comparing the CNN's melanoma probability scores of 20 nevi with in vivo markings (as shown in A) to the same 20 nevi with electronically superimposed markings (as shown in D) no significant differences were found.

eTable. Characteristics of Melanomas Including Localization, Invasiveness, and Histopathology

	Melanomas n=23 (%)	
Localization		
Non-glabrous common skin	18	(78.3%)
Palmoplantar skin	1	(4.3%)
Facial skin	3	(13.0%)
Hairbearing scalp	1	(4.3%)
Mucosa	0	(0.0%)
Invasiveness (melanomas)		
In situ melanoma	4	(17.4%)
Invasive melanoma	19	(82.6%)
Melanoma histotypes		
In situ melanoma	3	(13.0%)
Lentigo maligna (in situ)	1	(4.3%)
Superficial spreading melanoma	15	(65.2%)
Lentigo maligna melanoma	2	(8.7%)
Acrolentiginous melanoma	1	(4.3%)
Nodular melanoma	1	(4.3%)