

RESEARCH LETTER

Comparing Improvements in Biopsy Decision Making with Electrical Impedance Spectroscopy Between US and German Dermatologists

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ABSTRACT

Electrical impedance spectroscopy (EIS) is a noninvasive tool that measures the electrophysical properties of pigmented lesions, generating a score to aid in the differentiation of benign and malignant lesions. This research letter compares two studies, conducted in the United States (US) and Germany, evaluating the impact of EIS on biopsy decision-making among dermatologists. Both studies used the same set of clinical and dermoscopic images along with EIS scores for 49 lesions. Findings revealed that American dermatologists had a higher rate of correct biopsy decisions for malignant melanomas (MMs) and severe dysplastic nevi (SDNs) compared to their German counterparts. However, German dermatologists showed greater accuracy in avoiding unnecessary biopsies of benign pigmented skin lesions (PSLs). The addition of both dermoscopy and EIS significantly improved biopsy decision accuracy for MMs and SDNs in both groups, with EIS further mitigating initial reductions in correct biopsy choices for benign lesions. Differences in practice patterns, training, and malpractice concerns may explain the observed variations between US and German dermatologists. These results underscore the utility of EIS as a complementary tool to dermoscopy, enhancing the accuracy of biopsy decisions and improving patient outcomes.

Electrical impedance spectroscopy (EIS) sends a painless, low-voltage current through a pigmented lesion to identify the likelihood it is malignant.¹ The EIS device is able to differentiate between benign and malignant tissue based on their different electrophysical properties. The EIS device then generates a score from 0-10, with 0-3 suggesting the lesion is not melanoma (with a 99% negative predictive value) and 4-10 corresponding to

increasing positive predictive values for the lesion being a malignant melanoma (MM).²⁻⁴ Our research team conducted two published studies evaluating the ability of an EIS score to improve biopsy decision making of pigmented lesions based on clinical and dermoscopic photos.^{5,6} One study was performed in the United States (US) and the other study was performed in Germany. In this letter, we compare the results of the two

studies and discuss key differences between the two sample populations of dermatologists.

In both studies, the same 49 images of MMs (n=17), severe dysplastic nevi (SDNs) (n=6), and benign pigmented skin lesions (PSLs) (n=26) were utilized. These images had been randomly chosen from a separate study that had final dermatopathology results available.⁴ After receiving a review of the technology and its clinical usage, 151 German dermatologists and 231 US

dermatologists completed the survey (73% and 77% response rates, respectively). Each lesion was associated with a set of three images consisting of a clinical picture, a dermoscopic image, and the corresponding EIS score. Participants noted if they would biopsy the lesion after first viewing the clinical image, then after seeing the dermoscopic image, and again after receiving the EIS score for each lesion. The data from the German study was compared to the data from the American study using difference between two proportions.

Table 1. Comparison of correct and incorrect biopsy choice for US and German dermatologists evaluating the same lesions

Category	German Dermatologists N=151	US Dermatologists N=231	Significance of Difference
Melanoma (n=17)			
Clinical Image Correct	56.2%	79.9%	p<0.00001
Clinical Image + Dermoscopy Correct Biopsy Choice	78.9%	85.2%	p<0.00001
Clinical Image + Dermoscopy + EIS Score Correct Biopsy Choice	86.2%	91.1%	p<0.00001
Severe Dysplastic Nevi (n=6)			
Clinical Image Correct	43.8%	59.8%	p<0.00001
Clinical Image + Dermoscopy Correct Biopsy Choice	62.7%	69.3%	p=0.00112
Clinical Image + Dermoscopy + EIS Score Correct Biopsy Choice	68.1%	79.1%	p<0.00001
Benign Melanocytic and Mild-Moderate Dysplastic Nevi (n=26)			
Clinical Image Correct	59.7%	39.8%	p<0.00001
Clinical Image + Dermoscopy Correct Biopsy Choice	48.0%	34.9%	p<0.00001
Clinical Image + Dermoscopy + EIS Score Correct Biopsy Choice	58.7%	41.5%	p<0.00001

The results of the analysis comparing the rate of correct biopsy choice for American and German dermatologists evaluating the same lesions are shown in **Table 1** and **Figures 1, 2 and 3**. Combining the data for MMs and SDNs, the German dermatologists made the correct biopsy decision in 53.0% of cases with just the clinical image compared to 74.7% of cases for American dermatologists ($p < 0.00001$). With the addition of dermoscopy, German dermatologists made the correct biopsy decision in 74.6% of cases compared to 81.07% of cases for American dermatologists ($p < 0.00001$). Finally, with the addition of EIS scores, German dermatologists made the correct biopsy

decision in 81.5% of cases compared to 88.0% of cases for American dermatologists ($p < 0.00001$). For benign PSLs, German dermatologists made the correct biopsy decisions in 59.7% of cases compared to 39.8% of cases for American dermatologists ($p < 0.00001$). With the addition of dermoscopy, German dermatologists made the correct biopsy decision in 48.0% of cases compared to 34.9% of cases for American dermatologists ($p < 0.00001$). Lastly, with the addition of EIS scores, German dermatologists made the correct biopsy decision in 58.7% of cases compared to 41.5% of cases for American dermatologists ($p < 0.00001$).

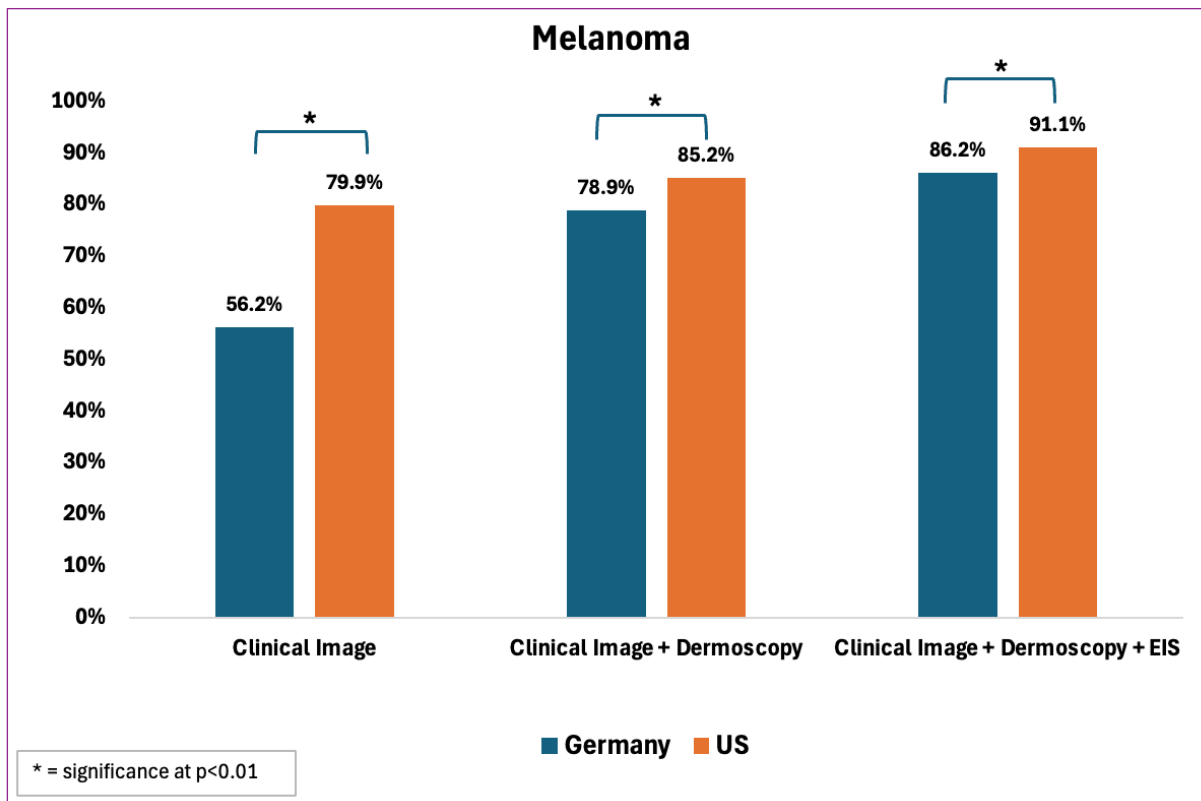


Figure 1. Comparison of correct biopsy rates for US and German dermatologists evaluating melanomas

The results are similar in that the addition of both dermoscopy and EIS created a statistically significant increase in correct biopsy choice for both MMs and SDNs. For benign lesions, both studies showed that the

addition of dermoscopy created a statistically significant initial decrease in the rate of correct biopsy choice. However, both studies also demonstrated a subsequent increase in the rate of correct biopsy choice with the

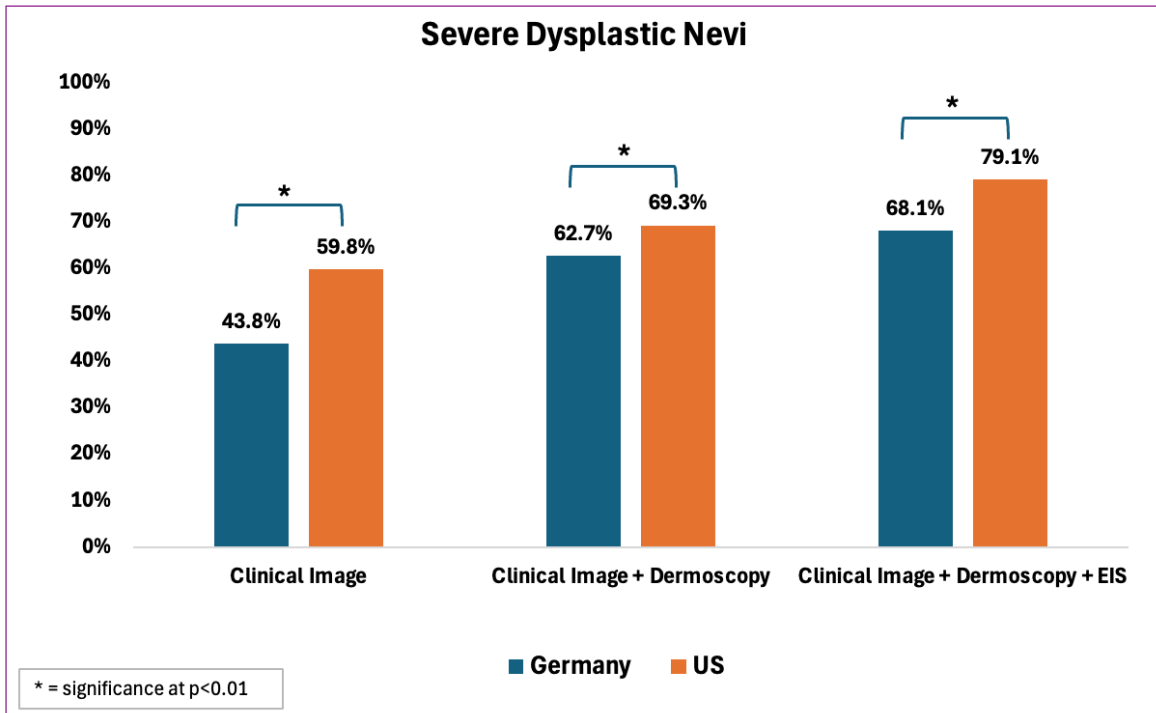


Figure 2. Comparison of correct biopsy rates for US and German dermatologists evaluating severe dysplastic nevi

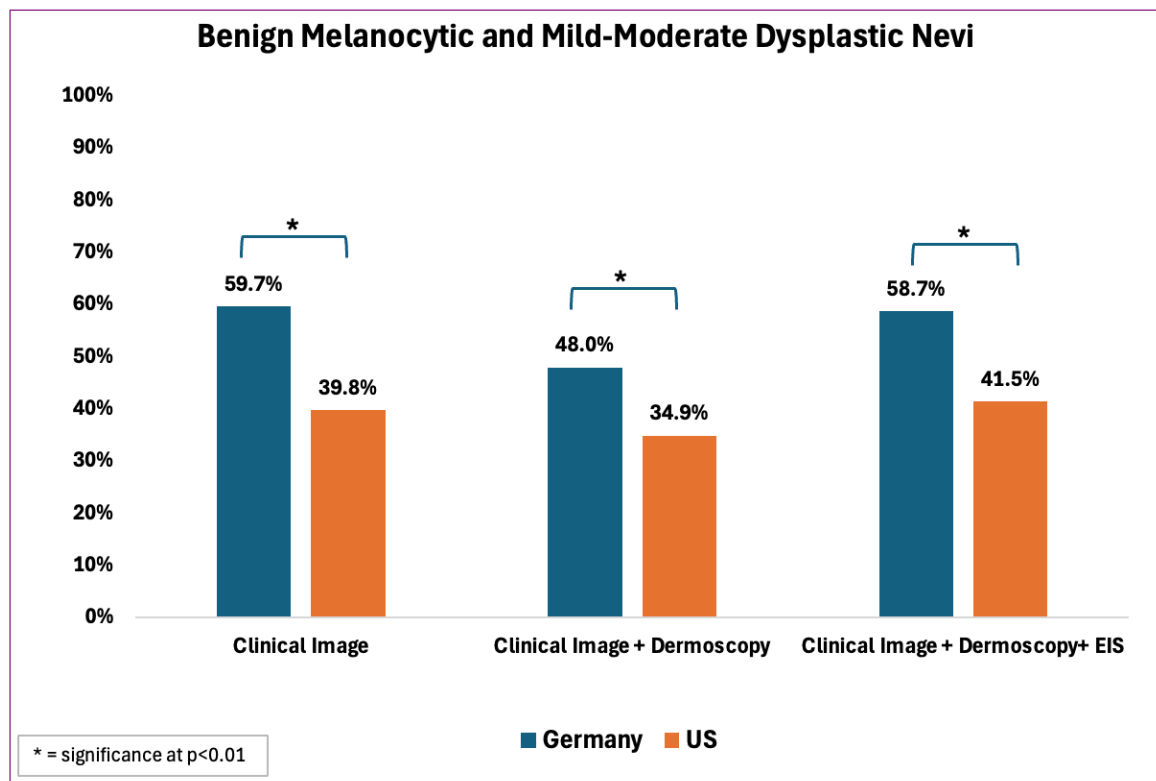


Figure 3. Comparison of correct biopsy rates for US and German dermatologists evaluating benign melanocytic and mild-moderate dysplastic nevi

addition of EIS. The American dermatologists had a significantly higher rate of correct biopsy choice for MMs and SDNs but had a significantly lower rate of correct biopsy choice for benign PSLs, suggesting that they had a lower overall threshold for biopsying a PSL than did their German counterparts. This result may be due to higher malpractice concerns by American dermatologists, with an estimated malpractice risk as high as 5-6% per year.⁷ While no data was available for German dermatologists, one study showed that the malpractice risk for orthopedic surgery was significantly higher in the US (26%) than in Germany (14%).⁸ Other explanations may include differences in training with dermoscopy or practice habits. These two studies demonstrate the value of incorporating additional tools that can accurately and noninvasively detect MMs. Dermoscopy is one tool that has become ubiquitous in Dermatology offices and has been shown to improve biopsy decisions, as seen in these two studies. However, these studies also demonstrate that further improvement is possible with the addition of EIS, and patients could further benefit from more accurate detection of benign and malignant lesions.

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