In vivo confocal microscopy in clinical practice: Comparison of bedside diagnostic accuracy of a trained physician and distant diagnosis of an expert reader

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Background: Reflectance confocal microscopy (RCM) is an imaging tool that allows the visualization of cellular details without biopsy. To our knowledge, RCM sensitivity and specificity has not been studied in a telemedicine setting.

Objective: We sought to assess RCM diagnostic accuracy in a support teleconsultation setting.

Methods: Between June 2010 and September 2011, 340 lesions were imaged using a confocal scanning microscope. The images were evaluated by 2 readers, one on site, and the other at a distance.

Results: A total of 334 cases were included. For each reader the sensitivity was greater than 90% and specificity for each reader was greater than 60%. Both readers had a combined sensitivity of 98.6% and 44% specificity.

Limitations: RCM may be limited in the correct classification of epithelial tumors.

Conclusions: RCM is a tool in the clinical diagnosis of skin lesions, providing a high diagnostic accuracy in teleconsultation use. (J Am Acad Dermatol 2013;69:e295-300.)

Key words: cutaneous lesions; noninvasive imaging; reflectance confocal microscopy; teledermatology.

Reflectance confocal microscopy (RCM) is a noninvasive imaging technique that allows for in vivo optical sectioning and real-time visualization of the skin up to a depth of 200 μm with histologic resolution.[1,2] Many studies have been conducted to establish algorithms for the diagnosis of malignant melanoma (MM), basal cell carcinoma (BCC), squamous cell carcinoma (SCC), and other suspicious lesions.[3-7]

A limitation of RCM is the need for dedicated training[8] with the existance of very few experienced readers and the presence of only black-and-white horizontal section images.[2,9] Despite good correlation

Abbreviations used:	
AK:	actinic keratosis
BCC:	basal cell carcinoma
MM:	malignant melanoma
RCM:	reflectance confocal microscopy
SCC:	squamous cell carcinoma
SK:	seborrheic keratosis

to histopathology,[10-13] it is still an evolving technology[14] The implementation of a system for image transfer to expert centers (Vivanet) (Vivascope 1500, Caliber ID, Rochester, NY) opens a new window for

diagnosis support.[15] Reliability of teleconsultation with RCM images has not been tested.

Our goal in this study was to assess the diagnostic accuracy of confocal microscopy as compared with histology in the diagnosis of cutaneous lesions in the clinical setting and distant diagnosis by 2 readers with varying degrees of experience.

METHODS
Patients

All the patients selected for this institutional review board–approved study were from the United States and had lesions that had been selected for removal for either cosmetic or medical reasons. A total of 340 lesions were imaged between June 2010 and September 2011. Six cases were excluded from the study because of insufficient information.

Imaging protocol and evaluation

Lesions were imaged using a confocal scanning laser microscope (Vivascope 1500, CaliberID, Rochester, NY). An imaging protocol allowed for the capture of 1 dermoscopic image and 4 RCM images (4×4-8×8 mm) for each lesion. Vivablock (Vivascope 1500, Caliber ID, Rochester, NY) mosaics were captured at the superficial spinous/granular layer, dermoepidermal junction, papillary dermis, and more reticular dermis. Two Vivastacks, corresponding to a series of consecutive high-resolution 0.5- $\times$ 0.5-mm images starting from the stratum corneum to the dermis were taken.

The images were reviewed by 2 confocal readers, one in New York, NY (reader 1), and the other in Modena, Italy (reader 2). Reader 1 at the start of the study had less experience reading RCM images compared with reader 2, who had over 9 years of experience with RCM. Images were sent via Vivanet (CaliberID, Rochester, NY), a Health Insurance Portability and Accountability Act–compliant server.[15] A diagnosis was based on the dermoscopic image and confocal microscopy evaluation before excision. After the imaging, each lesion was biopsied and sent for histology.

Statistics

Statistical analysis was performed using a statistical software package (SPSS 20.0.0, IBM Corp, Armonk, NY).

CAPSULE SUMMARY

- Confocal microscopy is currently used in research settings and has been shown to have good diagnostic accuracy when used in the examination of skin lesions.

- This study examines the use of confocal microscopy in a clinical setting in patients with suspicious lesions with both an onsite reader and a teleconsultant.

- The findings of this study indicate the usefulness of confocal microscopy as in-office tool.

The sensitivity numerator value corresponded to the total number of malignant lesions (MM, BCC, and SCC) diagnosed as such or recommended for excision. The specificity numerator value accounted for the total number of benign lesions (including nevi, seborrheic keratosis (SK)/solar lentigo, or other benign diagnoses) diagnosed as such and not recommended for excision. For sensitivity and specificity calculation, actinic keratoses (AKs) were considered intermediate and were excluded from analysis.

RESULTS

A total 334 cases were included. Of the included cases, truncal lesions accounted for 135 cases (40.4%). The rest included lesions from the face (90 cases, 26.9%), upper limbs (70 cases, 21%) and lower limbs (39 cases, 11.7%). Based on histologic diagnosis, there were 79 malignant cases that included MM (9 cases, 2.7%), BCC (27 cases, 8.1%), and SCC (43 cases, 12.9%). The remaining 255 cases included nevi (182 cases, 54.5%), AK (26 cases, 7.8%), SK/solar lentigo (24 cases, 7.2%), and other benign lesions including lichen planus–like keratoses, dermatofibromas, angiokeratomas, and angiomas (23 cases, 6.9%).

Two confocal readers diagnosed lesions based on RCM images. This diagnosis was compared with the histopathological diagnosis. Reader 1 evaluated 317 of 334 cases (94.9%); 17 cases were not evaluated because of insufficient information. The sensitivity for reader 1 was 93.1% and specificity was 64.1%. Reader 2 evaluated 323 of 334 cases (96.7%), with a sensitivity and specificity of 97.4% and 80.5%, respectively.

To measure the diagnostic performance of each reader, RCM and histopathological diagnosis for each lesion were compared (Table I). For reader 1, RCM diagnosis was in agreement with histopathological diagnosis in 83.2% of nevi (23.1% recommended for excision), 58.3% of SK/solar lentigo (8.3% recommended for excision), and 17.3%% of other benign lesions (4.3% recommended for excision). Lesions diagnosed by reader 1 as malignant with RCM represented 66.7% of histologically diagnosed MM, 74.1% of BCC, and 37.2% of SCC. The 23.1% of AK were classified as such, whereas 34.6% and 11.9% were diagnosed as BCC and SCC, respectively. Considering misclassified