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Preliminary imaging of skin lesions with near-infrared, portable confocal microscopy

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Keywords

reflectance confocal microscopy; portable confocal microscopy; skin cancer; basal cell carcinoma

Reflectance confocal microscopy (RCM) is a non-invasive imaging method that can visualize cellular details of the skin *in vivo*[1]. Through multiple clinical studies, RCM has been shown to provide high diagnostic accuracy for major skin cancers. In 2017, RCM was awarded common procedural terminology (CPT) reimbursement codes[2]. While clinical adoption of RCM has been steadily increasing, the high device cost (>$75,000) remains one of the key hurdles in widespread adoption of RCM. Previously, we have developed a portable confocal microscope (PCM) and demonstrated confocal imaging of skin lesions in Uganda[3]. Recently, we have developed an improved PCM device that uses near-infrared light[4], similar to the standard RCM device (Vivascope 1500, Caliber ID).

We evaluated the near-infrared PCM device for imaging skin lesions commonly encountered in dermatology clinics. The PCM device (Fig. 1) had dimensions of 22 × 17.5 × 10 cm^3 and weight of 1 kg, and built with a material cost of ~$5,000. Lateral and axial resolution was 1.6 and 6.0 μm, respectively, similar to the RCM resolution, 1.25 and 5 μm. Confocal images were acquired at the speed of 20 frames/sec, and transferred to a laptop. Ten skin lesions from five patients were imaged with the PCM device at the Banner-University Medicine Dermatology Clinic (Tucson, Arizona). Multiple areas were imaged for each skin lesion.

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Conflicts of Interest: CG and DK are inventors on US patent applications (University of Arizona, assignee) on the portable confocal microscopy technology presented. The University of Arizona has a technology-licensing agreement with ArgosMD on the presented technology. CG and DK have rights to receive royalties as a result of this licensing agreement. DK serves as a scientific advisor to ArgosMD.

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Imaging depth was adjusted by gently changing the pressure on the skin. The same lesions were also imaged with the standard RCM device.

PCM images visualized previously-validated RCM features for common skin lesions. For basal cell carcinoma (BCC), PCM clearly revealed the key diagnostic features such as tumor islands (Fig. 2a) and convoluted blood vessels (Fig. 2b) in a similar manner to the images obtained with the standard RCM device (Figs. 2d,e). In a PCM image obtained from another BCC lesion (Fig. 2c), hypopigmented tumor islands were visualized as dark silhouettes similarly to the image obtained with the standard RCM device (Fig. 2f).

Characteristic features of benign lesions were also revealed in PCM, irregularity in keratinocyte size and shape (Fig. 2g) in actinic keratosis (AK), curved and tubular vessels (Fig. 2h) in seborrheic keratosis (SK), and edged papillae (Fig. 2i) in melanocytic nevi, similarly to RCM images (Figs. 2j–l). The primary limitation we identified when using the PCM device is that the images sometimes appear blurry since stable connection between the device and skin was difficult to maintain. Efforts are undergoing to overcome this limitation, including increasing the imaging speed.

In conclusion, results from pilot imaging with PCM showed promise in visualizing key RCM features for common skin lesions. PCM working principle allows for adaptation of low-cost miniature optoelectrical components used in mobile devices, which can enable further miniaturization of PCM into a pen-sized, handheld device. Limitations of the pilot study include small number of patients and challenges in accurate spatial registration between PCM and RCM images. In the future, we will evaluate if PCM can visualize additional important RCM features and provide equivalent diagnostic accuracy to RCM.

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References

1. Milind Rajadhyaksha SG, Zavislan James M., Anderson R. Rox, Webb Robert H.. In vivo confocal scanning laser microscopy of human skin II : Advances in Instrumentation and comparison with histology. J Invest Dermatol 1999;Vol.113:293–303. [PubMed: 10469324]
2. Rajadhyaksha M, Marghoob A, Rossi A, Halpern AC , Nehal KS. Reflectance confocal microscopy of skin in vivo: From bench to bedside. Lasers in surgery and medicine 2017;49:7–19. [PubMed: 27785781]
3. Freeman EE, Semeere A, Laker-Oketta M, Namaganda P, Osman H, Lukande R et al. Feasibility and implementation of portable confocal microscopy for point-of-care diagnosis of cutaneous lesions in a low-resource setting. J Am Acad Dermatol 2020.
4. Gong C, Stratton DB, Curiel-Lewandrowski CN , Kang D. Speckle-free, near-infrared portable confocal microscope. Applied optics 2020;59:G41–G6. [PubMed: 32749315]

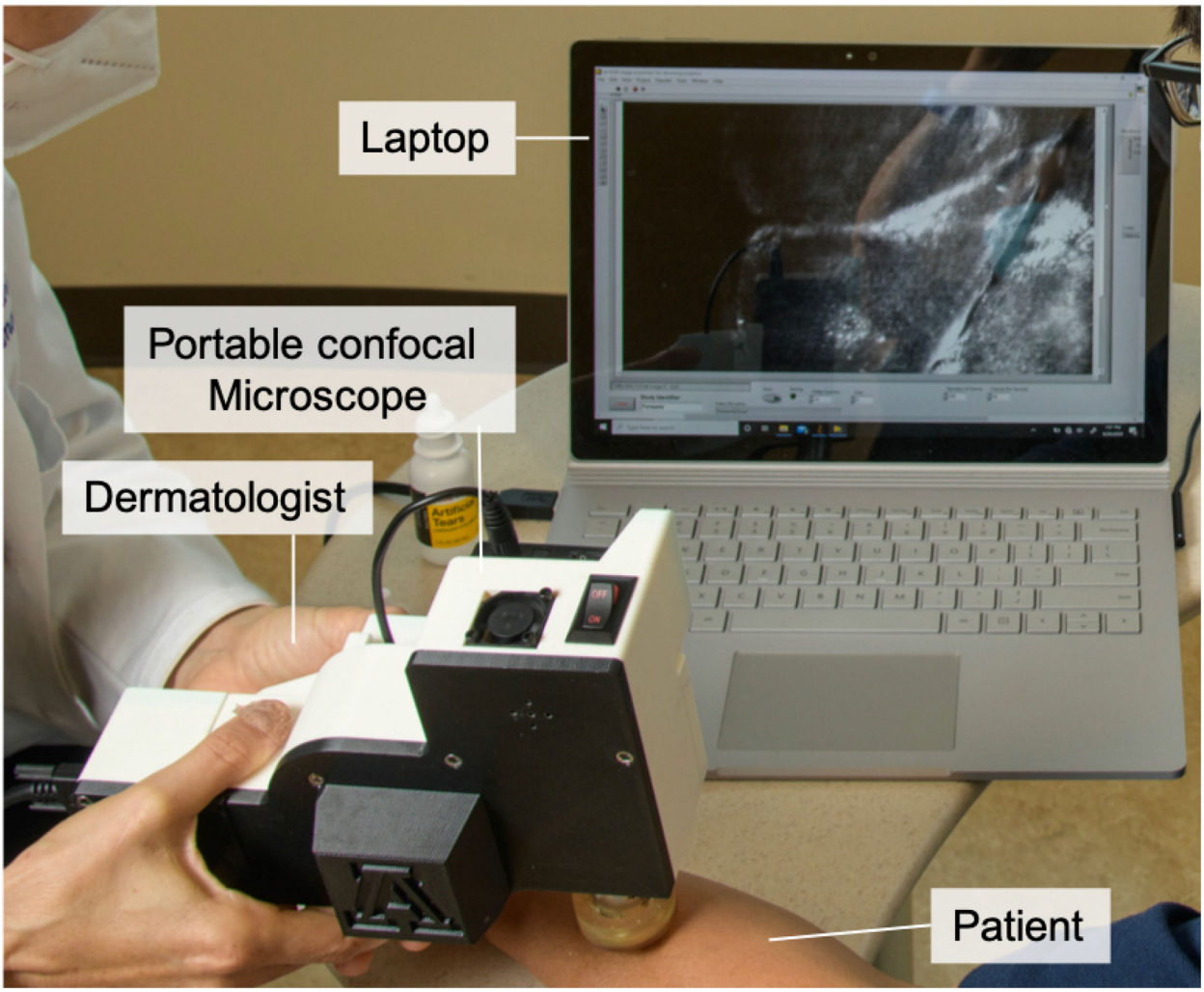

Figure 1.
Photo of portable confocal microscope used in dermatology clinic.

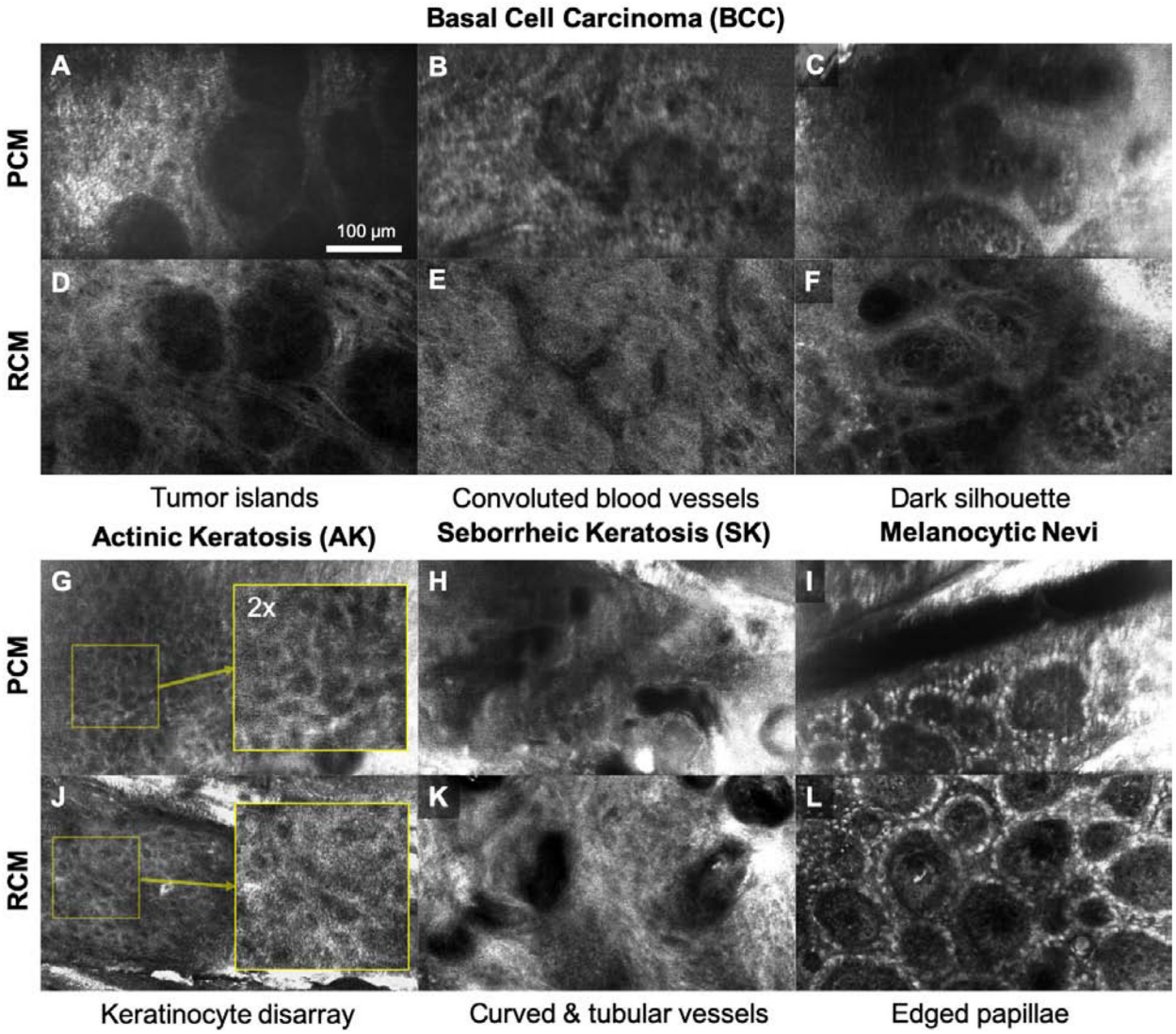

Figure 2.

Portable confocal microscopy (PCM) and reflectance confocal microscopy (RCM) images of skin lesions commonly encountered in dermatology care. A-C, G-I: PCM images; D-F, J-L: RCM images.