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Title: Laser-Induced Plasma Spectroscopy with deep learning algorithm for Real-time, In Vivo Skin Cancer detection: A next-generation diagnostic method

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Statement of the Problem: One in five Americans and two in three Australians are diagnosed with skin cancer during their lifetime. Non-melanocytic skin cancer (NMSC), including basal cell carcinoma (BCC) and squamous cell carcinoma (SCC), is the most common cancer in the U.S., the U.K., and Australia. The overall sensitivity for the clinical diagnosis of NMSC is only 56–90%. Moreover, the accuracy of the clinical diagnosis of malignant melanoma, even by dermatologists, is 49–81%. Although various skin cancer detection devices have been proposed, most of them are not used owing to their insufficient diagnostic accuracies.

Methodology & Theoretical Orientation: Laser-induced plasma spectroscopy (LIPS) can noninvasively extract biochemical information of skin lesions using an ultrashort pulsed laser. A Q-switched neodymium-doped yttrium aluminum garnet (Nd:YAG) laser with a wavelength of 1064 nm and pulse duration of 4 ns was used to irradiate the skin tissue and generate microplasma plumes. A laser beam with a diameter of 3 mm was focused on the target skin lesion using a plano-convex lens, anti-reflection coated at 750–1550 nm. The microplasma emission induced from the tissue was collected and delivered to the bifurcated optical fiber. In vivo LIPS spectra were acquired from 296 skin cancers (186 BCCs, 96 SCCs and 14 melanomas) and 316 benign lesions in a multisite clinical study. The diagnostic performance was validated using 10-fold cross-validations.

Findings: The sensitivity and specificity for differentiating skin cancers from benign lesions using LIPS and the DNN-based algorithm were 94.3% (95% CI: 91.6 – 96.9%) and 88.6% (95% CI: 85.1 – 92.1%), respectively. No adverse events, including macroscopic or microscopic visible marks or pigmentation due to laser irradiation, were observed.

Conclusion & Significance: This LIPS system with a DNN-based diagnostic algorithm is a promising tool to distinguish skin cancers from benign lesions with high diagnostic accuracy in real clinical settings.

Biography

Dr. Sung Hyun Pyun is a founder and Chief Executive Officer (CEO) of Speclipse, Inc. He received his Ph.D in mechanical engineering from Stanford University in 2012. Prior to founding Speclipse, he worked for the Boston Consulting Group and Korea Institute of Machinery and Materials for 6 years. He has published more than 20 papers in peer-reviewed journals. His main areas of research interest include laser spectroscopy and machine learning for medical diagnostics.